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MACHINE SHOP LOADING
by W. Winters

ANNUAL REPORT
Presented by the Council to the Annual General Meeting

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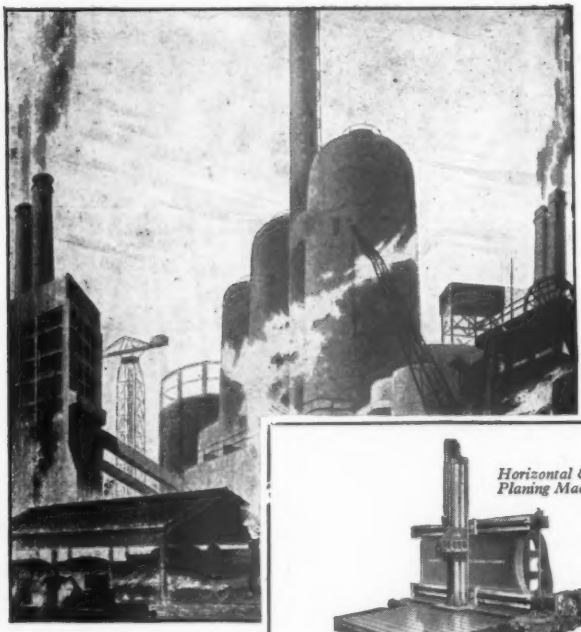

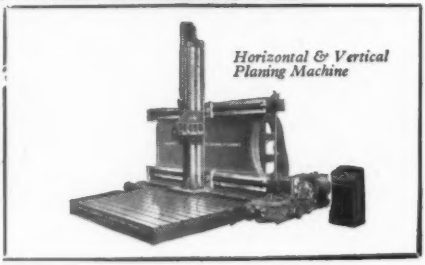

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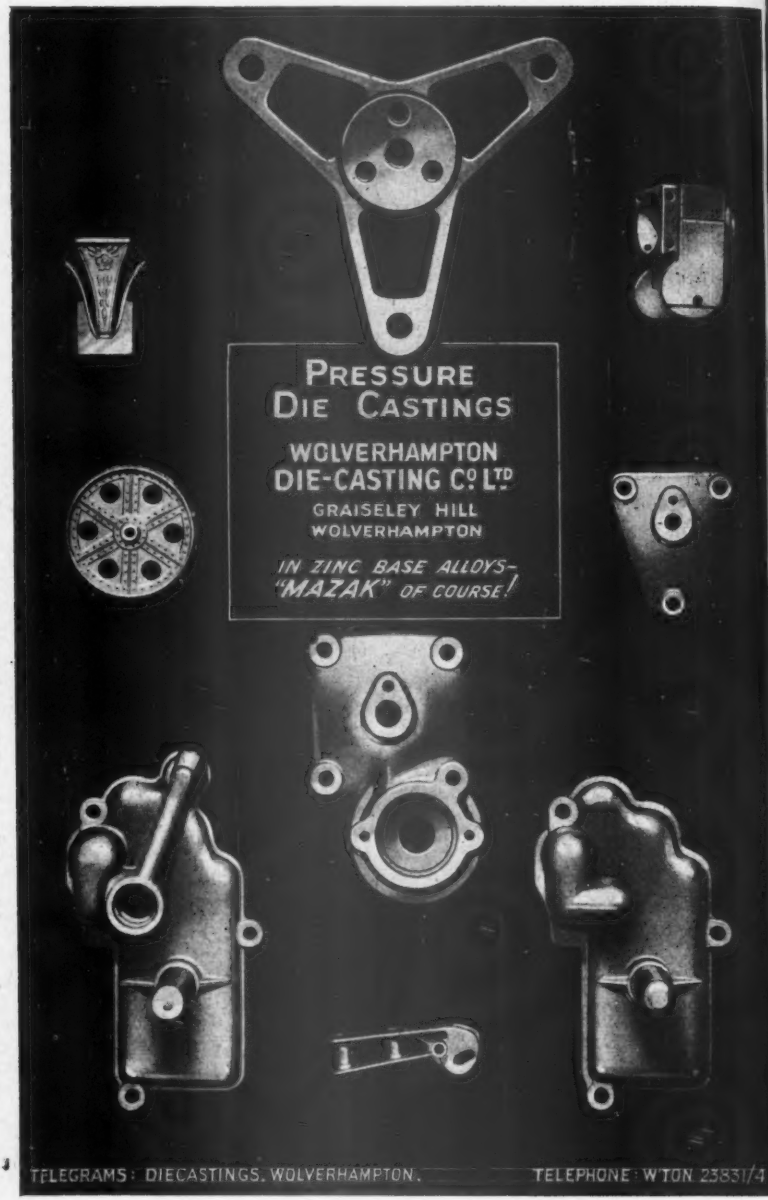
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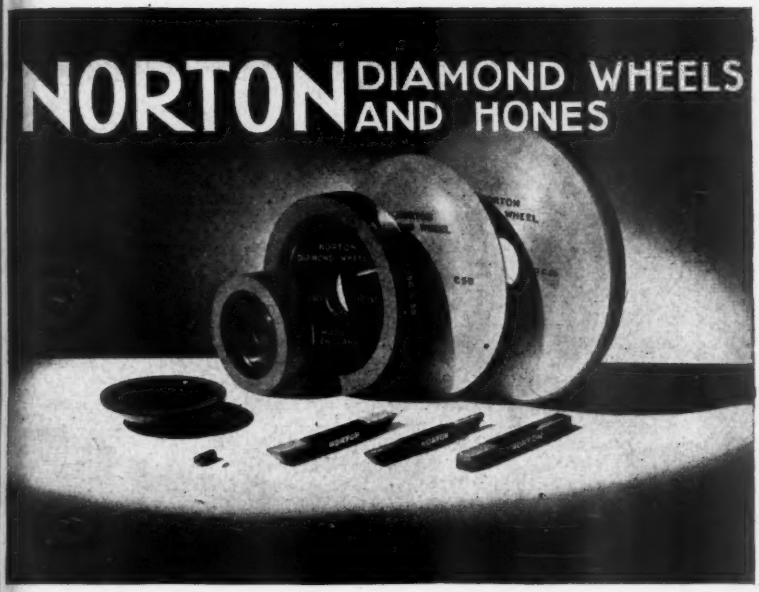

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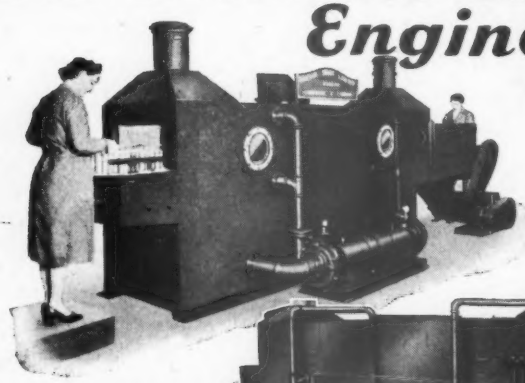

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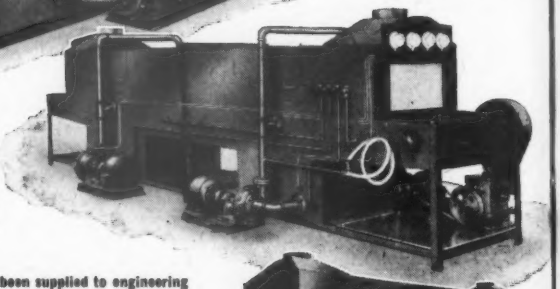

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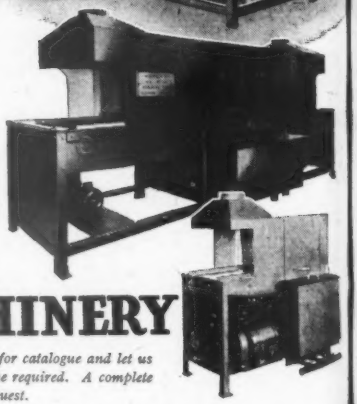

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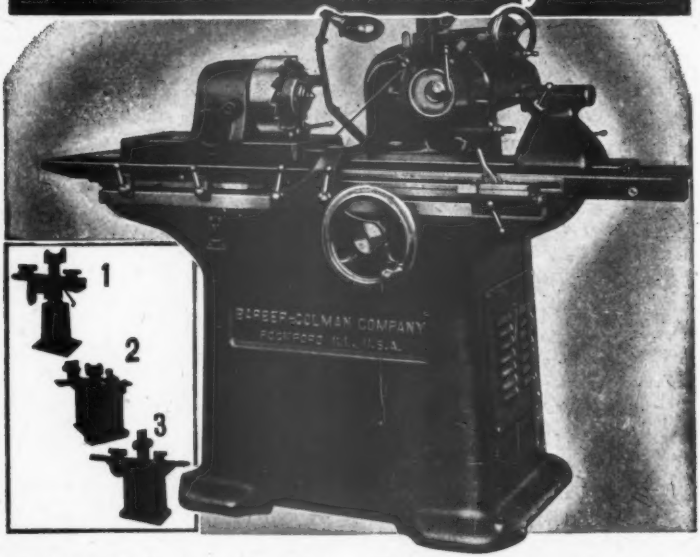

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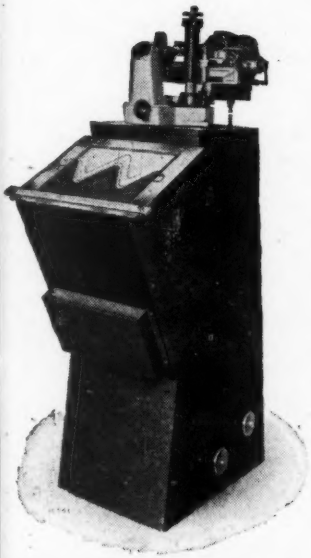

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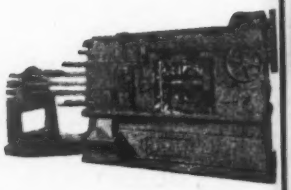

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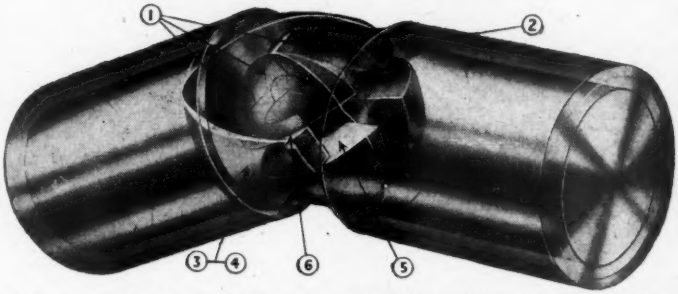

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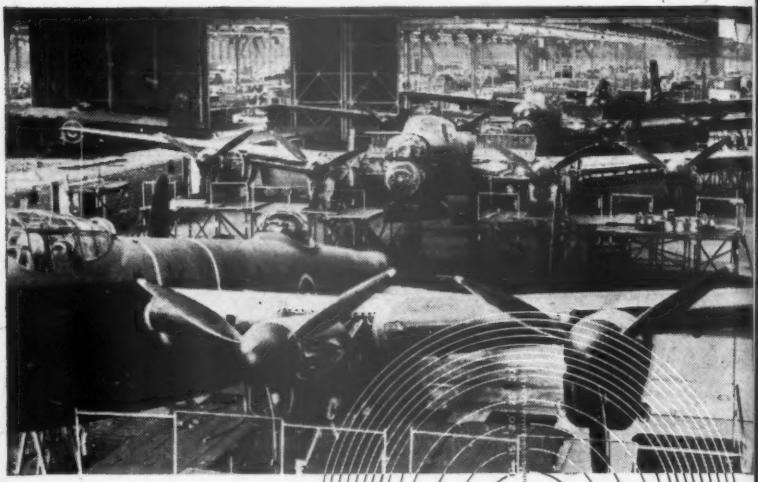

Lancasters on assembly—Photograph courtesy A. V. Roe & Co. Ltd.

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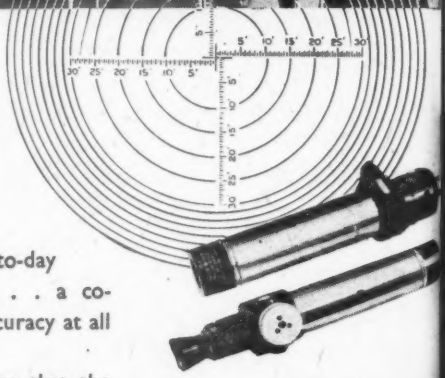

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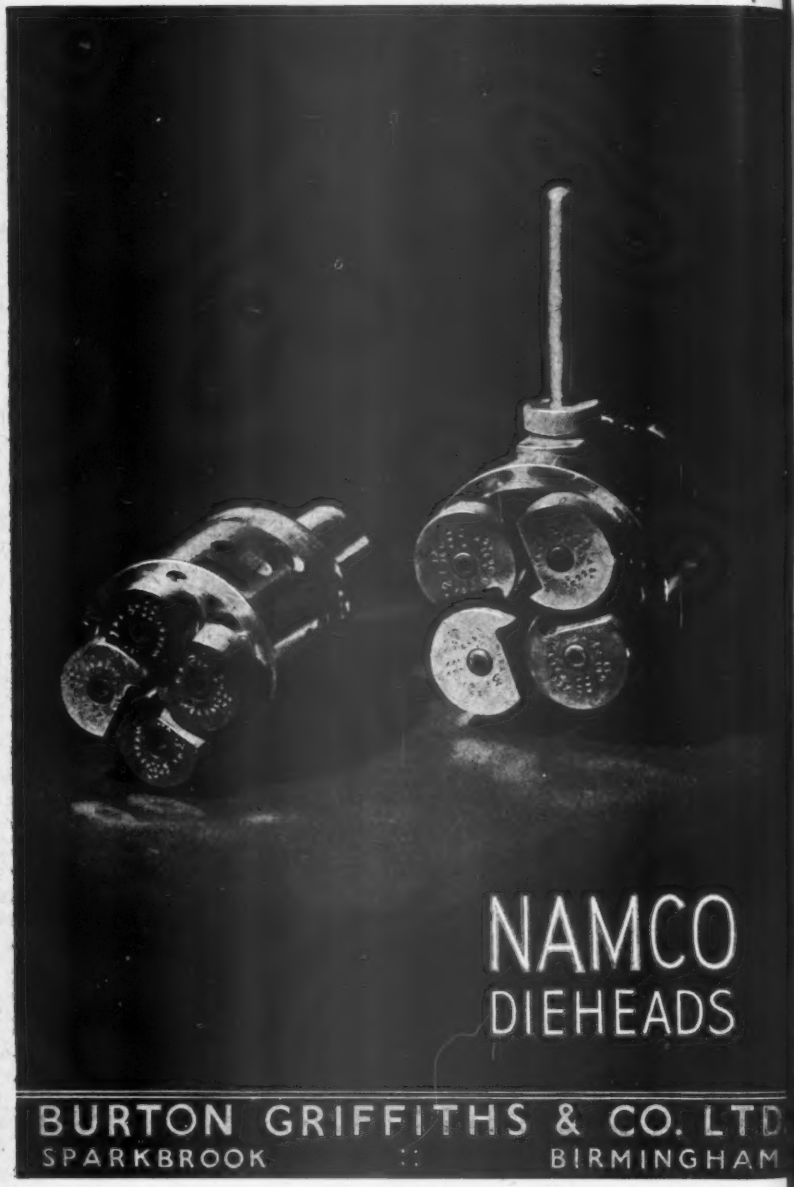
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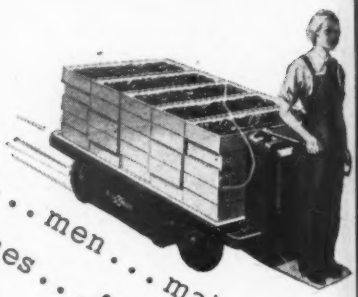

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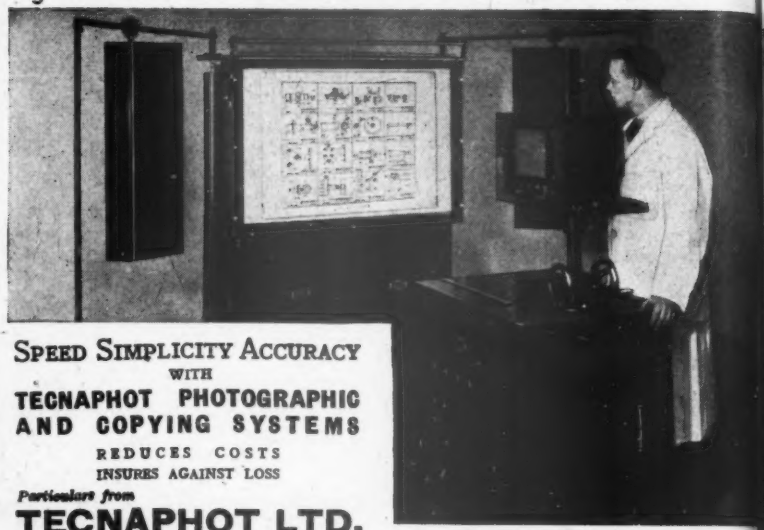

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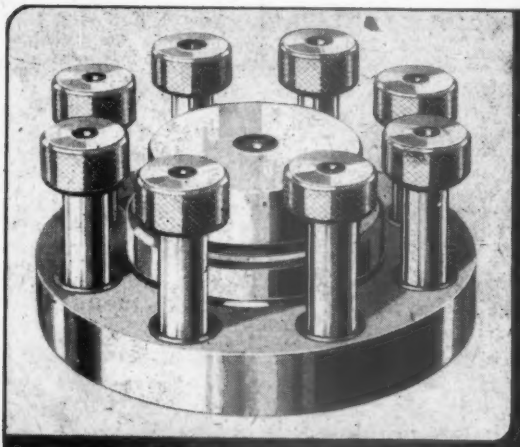

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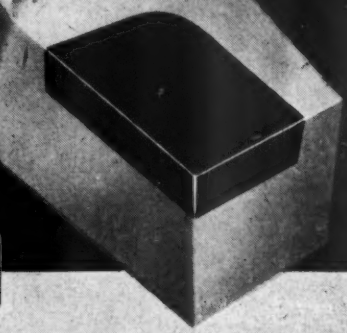

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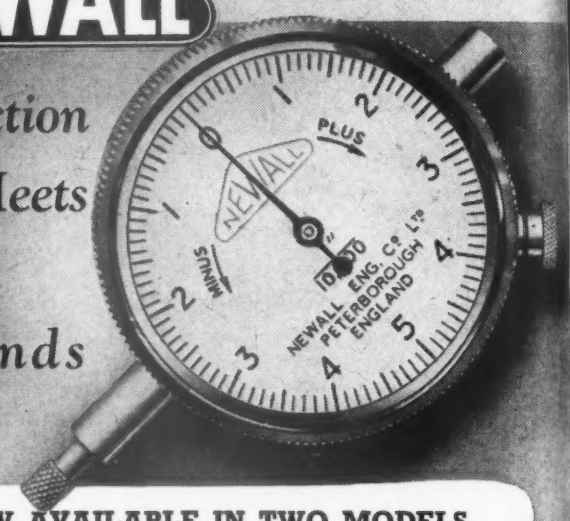

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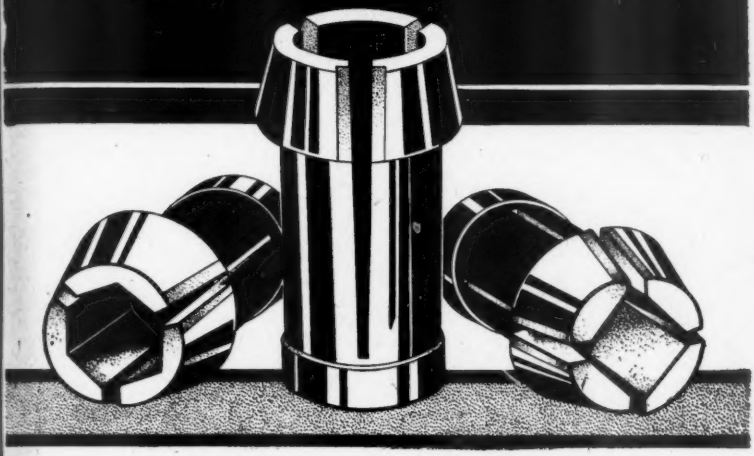

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PRINCIPLES OF
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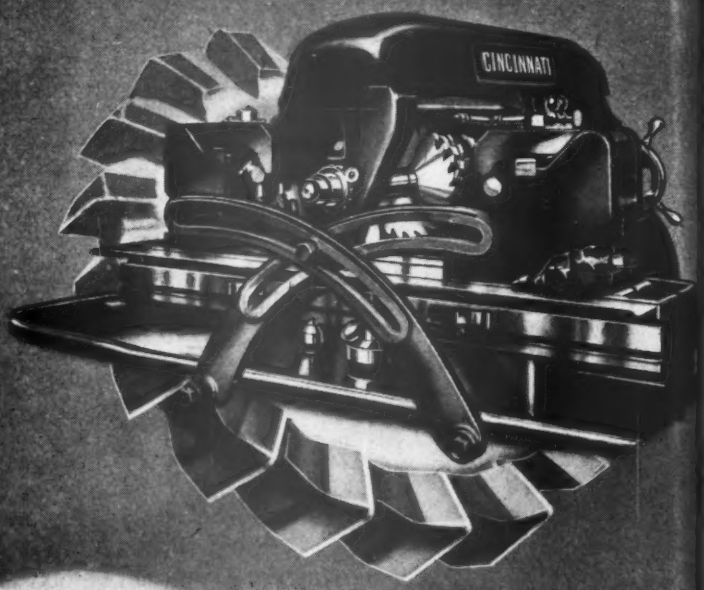

RECIPROCATING TABLE CYCLE

with right and left-hand fixtures enables loading to be done at one end of the table while milling proceeds at the other. This reduces both operator and machine idle time. The method demands a safety stop dog in the central table position to prevent accidents which might otherwise be caused by the cutters approaching partly loaded work. Where the cycle involves a 'climb' cut at one end of the table an effective table backlash eliminator is essential. You probably know of this principle. Do you know all the others ?

A fully illustrated art booklet based on an article entitled "Principles of Production Milling" which appeared in Vol. 2, No. 1 of the "Production and Engineering Bulletin", FREE on request.

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As a war-time measure the advertisement section of this Journal is now published in two editions, A *and* B. *Advertisers' announcements only appear in one edition each month, advertisements in edition* A *alternating with those in edition* B *the following month. This Index gives the page number and edition in which the advertisements appear for the current month.*

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The Council of the Institution

OCTOBER, 1943

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INSTITUTION NOTES

October, 1943

Meetings.

October 2—Yorkshire Graduate Section. A lecture will be given at The Hotel Metropole, Leeds, at 2-30 p.m. on "The Production of Surface Finish" by J. L. Hepworth, Esq., Grad.I.P.E.

October 4—Yorkshire Graduate Section. Works visit to Messrs. A. V. Roe & Co.

October 7—Leicester Section. A lecture will be given at The Leicester College of Technology at 7-0 p.m. on "Environment and Output" by K. G. Fenelon, M.A., Ph.D., General Secretary to the Institution.

October 8—Manchester Section. A lecture will be given at The Mechanical Institute, Crewe, at 7-15 p.m. on "Production Control" by R. Appleby, Esq., A.I.P.E.

October 8—Eastern Counties Section. A lecture will be given at The Ipswich Museum at 7-0 p.m. on "Local Hardening" by E. Bramhill, Esq.

October 9—Manchester Section. A lecture will be given at The University of Liverpool, Brownlow Hill, Liverpool, at 2-30 p.m. on "Production Control" by R. Appleby, Esq., A.I.P.E.

October 11—Coventry Graduate Section. A team of five experts will give impromptu answers to "Any Questions" Meeting at The Coventry Technical College (Room A5).

October 15—Leicester Section. A lecture will be given at The Leicester College of Technology at 7-0 p.m. on "Engineering Properties of Rubber and Application of Rubber to Metal Weld Devices" (Illustrated by films), by J. E. Moyal, Esq. (Messrs. Metalistik Ltd.).

October 16—North Eastern Section. A Social Evening at The Stuart Restaurant, Team Valley, Trading Estate, Gateshead, at 6-0 p.m. for 6-15 p.m.

October 20—Manchester Section. A lecture will be given at The College of Technology, Manchester, at 6-45 p.m. on "High Speed in the Wartime Production Shop" by Dr. G. Schlesinger, Hon M.I.P.E. (Director of Research Department of the Institution of Production Engineers).

October 20—Birmingham Section. A lecture will be given at The James Watt Memorial Institute, Birmingham, at 7-0 p.m. on "Furnace Copper Brazing as an Aid to Production" by N. G. Gillard, Esq.

October 21—Manchester Section. Members are invited by the N.W. Board of the Institution of Mechanical Engineers to a lecture at The Engineers' Club, Albert Square, Manchester, at 6-45 p.m. on "Surface Finish and the Function of Parts" by Dr. G. Schlesinger, Hon.M.I.P.E. (Director of the Research Department of the Institution of Production Engineers).

October 21—North Eastern Section. A lecture will be given at The Lecture Theatre, Neville Hall, Newcastle-on-Tyne, at 6-15 p.m. on "Plastics for the Engineer" by P. D. Richie, Esq., B.Sc., Ph.D.

October 22—London Graduate Section. A lecture will be given at 36, Portman Square, London, W.1. at 7-0 p.m. on "Training of Production Engineers" by W. Hewitt, Esq.

October 28—Glasgow Section. Annual General Meeting at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, followed by a lecture to be given at 7-0 p.m. on "The Regional Organisation of the Ministry of Production" by Lewis J. B. Forbes, Esq., Regional Controller for Scotland, Ministry of Production.

October 31—Luton Section. A lecture will be given at The Luton Library, Meeting Room, George Street, Luton, at 10-0 a.m. on "Metal Spraying" by W. E. Ballard, Esq., (Metallisation).

November 1—Sheffield Section. A lecture will be given at The Victoria Hotel, Sheffield, at 6-30 p.m., when an Open Discussion will take place on "The Pros and Cons of Works Joint Production Committee."

November 1—Coventry Graduate Section. A paper will be presented at the Coventry Technical College (Room A5), at 6-45 p.m. on "Car Planning Principles Applied to Air Frame Production" by B. G. L. Jackman, Esq., Grad.I.P.E.

November 3—Manchester Section. A lecture will be given at The College of Technology, Manchester, at 7-15 p.m. on "The Advantages of Using Plastics" by H. W. J. Inshaw, Esq.

November 5—Coventry Section. A lecture will be given at The Coventry Technical College (Room A5) at 6-45 p.m. on "Powder Metallurgy" by W. D. Jones, Esq., M.Eng., Ph.D.

November 6—Yorkshire Graduate Section. A lecture will be given at The Great Northern Hotel, Leeds, at 2-30 p.m. on "Plastics" by C. R. Williams, Esq.

November 13—Yorkshire Section. A lecture on "Output and Environment" by K. G. Fenelon, M.A., Ph.D., at The Hotel Metropole, Leeds, at 2-30 p.m.

November 20—Yorkshire Graduate Section. A works visit to Messrs. Birkbys Ltd., Plastic Moulders, Liversedge, at 2-30 p.m.

Lincoln Sub-Section.

The Inaugural Meeting of this Sub-Section will be held at the Technical College, Lincoln, on Friday, November 5, 1943. The Inaugural Address will be given by the President, Sir Ernest Lemon, O.B.E., and he will be supported by Lord Sempill and Mr. H. A. Hartley. The proceedings commence at 6-15 p.m.

London Graduate Section.

Forthcoming Meetings of the London Graduate Section which are to be held at Headquarters, 36, Portman Square, W.1., are as follows :—

October 22—"Training of Production Engineers" by Mr. Hewitt.

November 26—"Arc Welding as Applied to Jigs and Fixtures" by Mr. Spragg.

December 10—"Questions and Answers."

January 28—"Precision Measurements by Optical Methods" by Mr. Hume.

MACHINE SHOP LOADING

Paper presented to the Institution, Newcastle Section, on March 26, 1943, by W. Winters

THE paper I have been invited to read to-night, is a subject which is important to everyone engaged in production. Machine shop loading is very complex, being interwoven with planning and production control, and consequently, to try and cover the whole field affected by the subject, would be impossible in the time available and what is more, would not leave you with the impression I hope to leave.

I understand that there are many firms in the North East who have no system of machine loading and it is the representatives of these firms who I hope will benefit.

Line Production.

When we hear of production or see films or pictures of our War effort, it is nearly always line production. I do not know how many of us have had the opportunity of controlling this type of manufacture, but from my own experience, planning the original layout for line production requires a lot of hard work and attention to detail, such as the position of machines, handling of work, etc. When it is running, production control and machine loading are comparatively easy.

What I want to deal with to-night is the type of production with which most of us are connected, that is, batch production.

Machine Loading and Machine Utilization.

These are subjects which have recently become very prominent and visits by representatives of Machine Tool Utilisation and Ministry of Production have become very frequent. Questions are asked about our machine capacity by these Departments and other Ministries which are often very difficult to answer. When we consider some of these questions, such as,

1. Have you any milling capacity ?
2. What percentage of utilisation are you getting from a certain type of machine ?

quite a large percentage of Managers are unable to give an intelligent answer ; we must ask ourselves " why," and we invariably find that we have never analised our position. We do not know exactly what our assets in production capacity really are, so let us first of all get a picture of our position.

Type of Machine	Operations	Total Time		Number of Machines Required per 100 hr. week	Spare Cap'cty wkly. in hours
		Per piece in mins.	Per 350 in hours		
Hor. Mill. 18 in. ...	4-5-6-8-14-16-16A-17-18-19-20-21-24-27-33-36-40-42-43-62	84.75	495	5	—
Hor. Mill. 10 in. ...	39-66-65-67-68	20.0	117	1.17	—
Vert. Mill 18 in. ...	29	13.0	76	0.76	—
Vert. Mill. 10 in. ...	54-60-63-70-71-73-74	31.75	185	1.8	—
Profile 1.Sp.	28	2.50	15	0.15	—
Profile 2.Sp.	25	4.0	24	0.24	—
Hand Mill.	37-38-44-55-76	11.25	66	0.66	—
Spline Mill.	69	12.50	74	0.74	—
Deep Hole Drill. ...	11	11.0	64	0.64	—
Vert. Drill. 1.Sp. ...	47-48	6.0	35	0.35	—
,, ,, 2.Sp. ...	34-34A-72	15.25	89	0.89	—
,, ,, 3.Sp. ...	53-59	13.0	76	0.76	—
Capstan Lathe ...	12	20.0	116	1.16	—
Vert. Sur. Grinder ...	9-15	6.50	38	0.38	—
Centre Lathe	92	3.0	18	0.18	—
Hor. Sur. Grdr. 18×9×6	22-23-80-91-93-94	27.25	159	1.59	—

Fig. 1

In the case of small plant up to 200 machines, I would suggest the factory is dealt with as one unit. In the larger facrories, it would be more convenient to tackle the job in departments. For example, we will consider the unit either a small factory or a department of a large one.

We must first of all, analise our products, they are jobs which

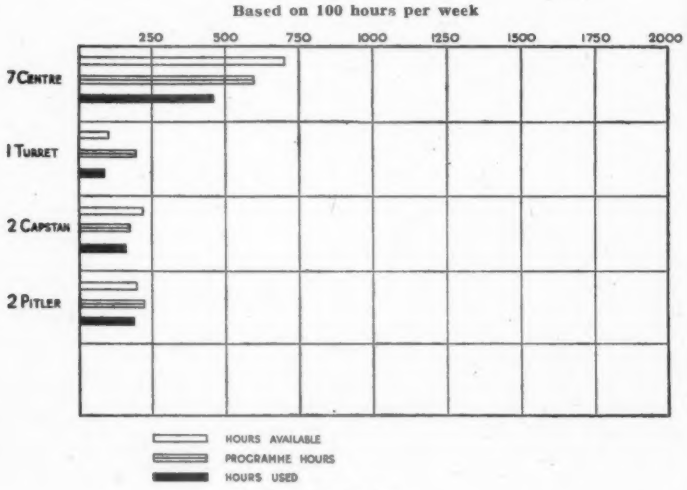


Fig. 2.—Lathes

MACHINE SHOP LOADING

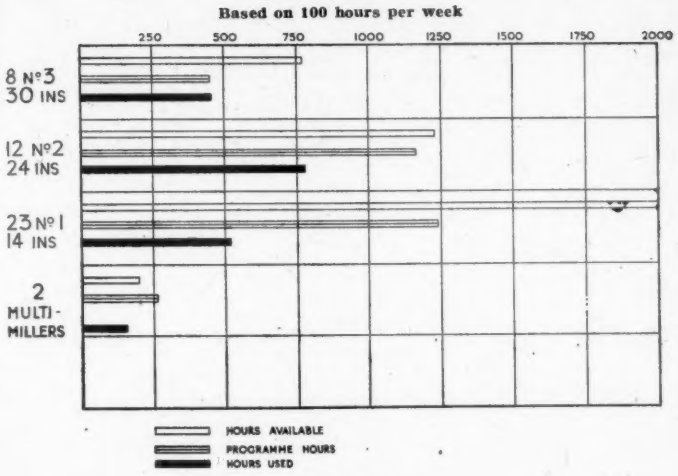


Fig. 3.—Horizontal millers

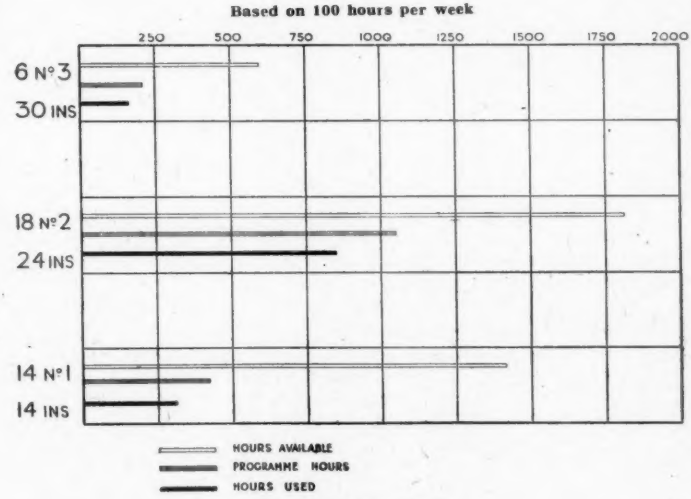


Fig. 4.—Vertical millers

are already being manufactured, and consequently, the most suitable type of machines for each operation is known, setting and machining time can be obtained from job cards or whatever form is used for payment, so that for each component, we can produce a picture similar to this (Fig. 1).

Here, we have the machine type—here operations carried out on that type of machine and—here the total number of hours required each week to meet our programme of 350 per week.

We must obtain a picture similar to this for each component and then by adding the results together, we find the loading of each type of machine and produce a series of charts something like (Figs. 2, 3 and 4). The blue line was the capacity being used before the shop was actually up to programme.

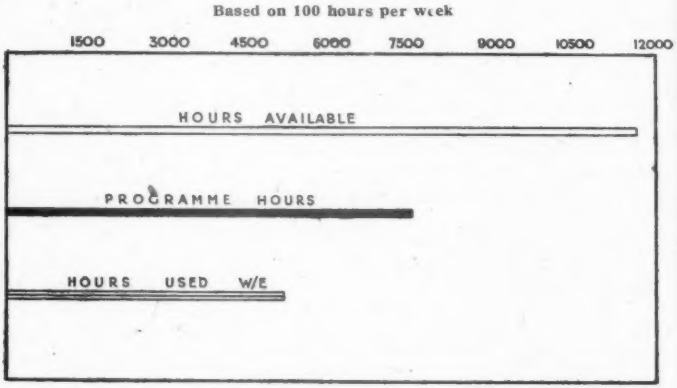


Fig. 5.—Total capacity

From these charts we are now in a position to produce the picture showing the total available machine capacity and to what extent it is being utilised (Fig. 5).

We will all agree, I am sure, that this looks a very bad picture, but it was the true position of the plant in a factory engaged on 1A priority work. I would strongly advise everyone here to produce a chart on these lines of their particular factory or department and I don't doubt that many of you will be very surprised.

Many of us, have been under the impression for too long that to chart information in the manner I have suggested, is of no practical value, but from my own experience, it is the only way we can get a true perspective of our assets and how we are utilising them.

Now that we have a complete picture of the situation—how to

improve the position is really a subject of a separate lecture, but I would like to mention one or two points which I am sure will help. We see here that some machines are fully loaded and others are not. The reason may be that our plant is completely unbalanced and that by the installation of a further machine of a type, the position could be considerably improved, or, we may find that there is a process such as heat treatment completely holding up the flow of work. One thing we can be sure, there is some definite reason for utilisation being out of balance and necessitates closest investigation to find out why.

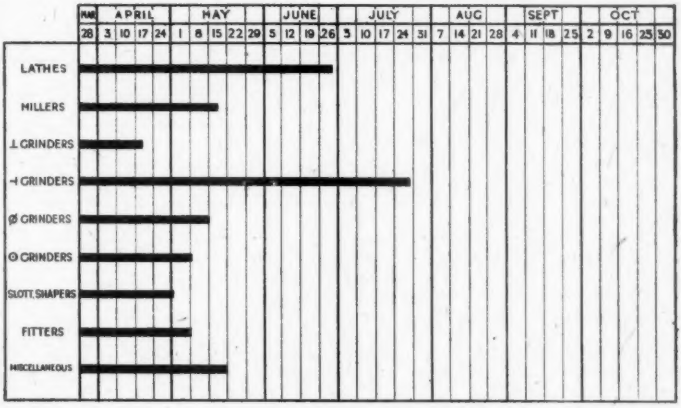


Fig. 6.—Toolroom capacity

Once the scheme for recording has been put into operation, it is essential that it must be kept up to-date, either weekly or four weekly whichever is suitable for the particular job of work we are making. If the work is a series of small orders, I would suggest that it should be recorded weekly. However, if we have running contracts, I think that a four weekly record should be quite adequate.

Apart from the fact that we have now a true reflection of our position, there are other uses for this information. We may be approached by a Government Department in connection with the manufacture of a new job. What is the first thing to do? We analise the best method of manufacture for the particular job and the machines required (Fig. 1) and then estimate the machine hours required for each operation, and the type of machines on which it is to be done. It is quite easy when we have this information, to look at our machine capacity chart and be in a position to say

MACHINE LOAD AND PRODUCTION CYCLE

PART No._____

OUTPUT 500 PER WEEK CYCLE 11 WEEKS

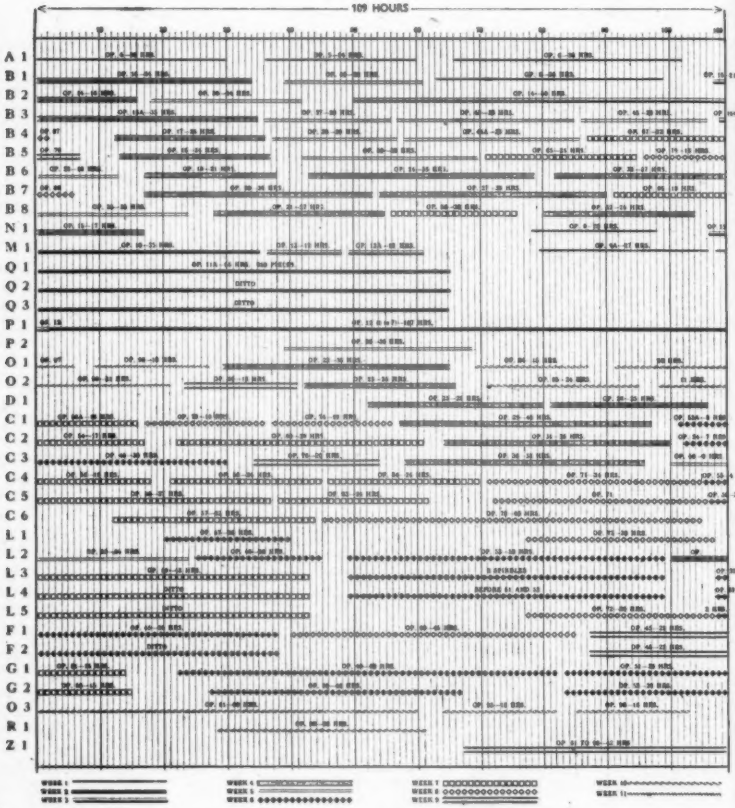


Fig. 7.

whether or not we can undertake the manufacture of the job in question or whether it will necessitate the installation of additional plant.

The reaction of some of the members here to-night will undoubtedly be that the particular job they are doing could not be dealt with in the manner I have suggested because they are only dealing with very small quantities. This scheme can be adapted for any type of production and it is possible to chart the loading of machine shop for any class of work.

For example, I have taken a tool room engaged on the manufacture of precision tools and gauges in quantities as low as 1 and 2. By planning the manufacture of each of these items and estimating the time for each operation, such as turning, milling, grinding, etc., we are able to load our plant in a manner shown on Fig. 6. From this we can see at a glance whether or not, we are able to take on further contracts involving these machines.

Up to the moment, we have concerned ourselves only with ascertaining the load of a *machine shop* as a unit, and to get an idea of our efficiency, I am quite certain if we only go as far as this, we shall be doing ourselves and the country a great service by seeing exactly what capacity becomes available and seeing that the Ministry of Production are acquainted with this information.

There is a continuation of this subject dealing with actual loading of each machine or groups of machines of similar type and arranging a programme for each group or individual machines. By this means, everyone from the setters upwards knows exactly what a machine should be doing each day in each week and consequently, leaves very little to chance.

I have reproduced a chart of components which has approximately 100 operations to be produced at the rate of 500 components per week on 28 machines. This means that there are 50,000 operations on every batch of 500 pieces. There are very few people who would be prepared to tackle a problem of this nature but it can be done, and the only means by which it can be done with any consistency is on scheme similar to the one I have outlined on Fig. 7.

There are two ways of approaching this problem. One is to build up the cycle from estimates. The other is to produce a sample batch of components so that the time study engineer can collect all his data from actual practice. Whichever method is used, it is a question of individual opinion. One thing we must bear in mind —is to make ample allowance for the variations which are likely to occur on a new job. and gradually tighten up as the production develops until ultimately we can be sure that a machine or a group of plant is loaded.

This arrangement of machine loading is considered to be rather advanced and really speaking, a little out of line with my subject of *machine shop loading*, but I have taken the opportunity of bringing to the notice of those members who have not been following this particular phase of production very closely.

In the future, I doubt if we shall be in a position to reduce the selling price of our products by cutting the earnings of machine operators and setters ; our only solution will be, fully investigating and improving methods of production and utilising our plant to the maximum. In other words, the machine hours are our capital. If they are utilised, they are an asset, if they are not utilised, they are a liability.

ANNUAL REPORT

Presented by the Council to the Annual General Meeting held in London on 29th October, 1943

THE past year has been an anxious and difficult one. The responsibility of war time production upon many of our members has prevented them from giving as much of their valuable assistance to the Institution as had been possible in the past, but it is hoped that the heartening news which is now being received from all theatres of war is indicative of the part which production engineers are playing in the fight for victory, and that the time will not be far distant when the help of these members will once again become available.

In spite of the difficulties encountered during the year, it will be seen from the following Report that much useful work has been accomplished, and the Council look forward to the future with confidence, knowing that they are well equipped to meet any new demands which may arise.

The Late General Secretary.

This report would be incomplete without reference to the severe loss which the Institution suffered in January last by the death of Richard Hazleton, for over 13 years the valued and honoured Secretary of the Institution. The high esteem in which Mr. Hazleton was held by members, friends, and kindred associations was reflected by the large number of letters of sympathy received.

A fitting tribute was paid to the late General Secretary in connection with the Requiem Mass which was celebrated at St. James's, Spanish Place, on 27th February, when a large number of members and friends gathered together to pay homage to the man who had played so large a part in the growth of the Institution.

To commemorate his memory the Council propose to establish a suitable memorial, and a special committee is considering what appropriate action should be taken.

Appointment of New General Secretary.

One of the main considerations of the Council arising out of the death of Mr. Hazleton was to appoint his successor, and accordingly a special committee was set up to investigate the position. It is pleasing to report that the Council have been fortunate in securing the services of Dr. K. G. Fenelon, M.A., who commenced his duties on 1st September. Dr. Fenelon was Director of the Department of

Industrial Administration at Manchester University. Amongst his many qualifications are :

Master of Arts (First Class Honours in Economic Science).
Doctor of Philosophy.
Medallist and Prizeman in both Ordinary and Honours Political Economy.
Merchant Company's Prize and Gladstone Prize in History, Economics and Political Science.

Positions Held.

1921—1931. Lecturer in Economics, Edinburgh University. Member of the University Extra-Mural Committee. Member of the Joint Advisory Committee on Adult Education in S.E. Scotland. Vice-President of the Workers Educational Association and subsequently President and Chairman of the Executive Council.

1931—1943. Director of the Department of Industrial Administration at Manchester College of Technology. Head of the Department of Industrial Administration, University of Manchester, supervising research students working for Master's and Doctor's degrees, post-graduate certificate course and courses in management for undergraduate students from mechanical engineering, electrical engineering, municipal engineering, chemical engineering, textiles, applied chemistry and other departments. Supervised also intensive war-time courses for Foreman, Woman Supervisors in Engineering, Quality Control by Statistical methods, Canteen Management, Cost Accountancy Trainees, Cost Office routine in wartime.

The Assistant Secretary.

During the interregnum the duties which normally fall to the General Secretary were carried out by Mr. J. F. Gibbons, who was able to continue the work of the Institution in spite of the fact that he had only taken up his appointment a few weeks when the illness of Mr. Hazleton required him to take over many heavy responsibilities. Subsequently he had to carry sole responsibility and it was due to him that the work of the Institution could be continued as fully and as effectively as it has been in such difficult circumstances. During this period Mr. Gibbons was responsible for the complete reorganisation of the office, necessitated by the rapid growth of the Institution.

The members of the Institution will feel greatly indebted to him for the heavy and exacting load which he has carried without complaint, and for having discharged his duties so efficiently and thoroughly. The Council desire to place on record their high appreciation of the valuable service rendered to the Institution by Mr. Gibbons under these very trying conditions.

Membership.

The important part which the Institution is playing in Industry is reflected by the ever increasing number of applications which are being received. In the twelve months ending June, 1943, a total of 1073 have been dealt with by Headquarters. Of these 636 have been elected.

It is particularly interesting to record that a large number of applications have been received for the Studentship grade, many of these candidates having been prompted to make application by their employers.

The membership at the end of June, 1943, was as follows :

Honorary Members	3
Ordinary Members	873
Associate Members	1,167
Associates	97
Intermediate Associate Members	532
Graduates	539
Students	250
Affiliates representing 155 Affiliated Firms less those already in other grades	133
	3,594

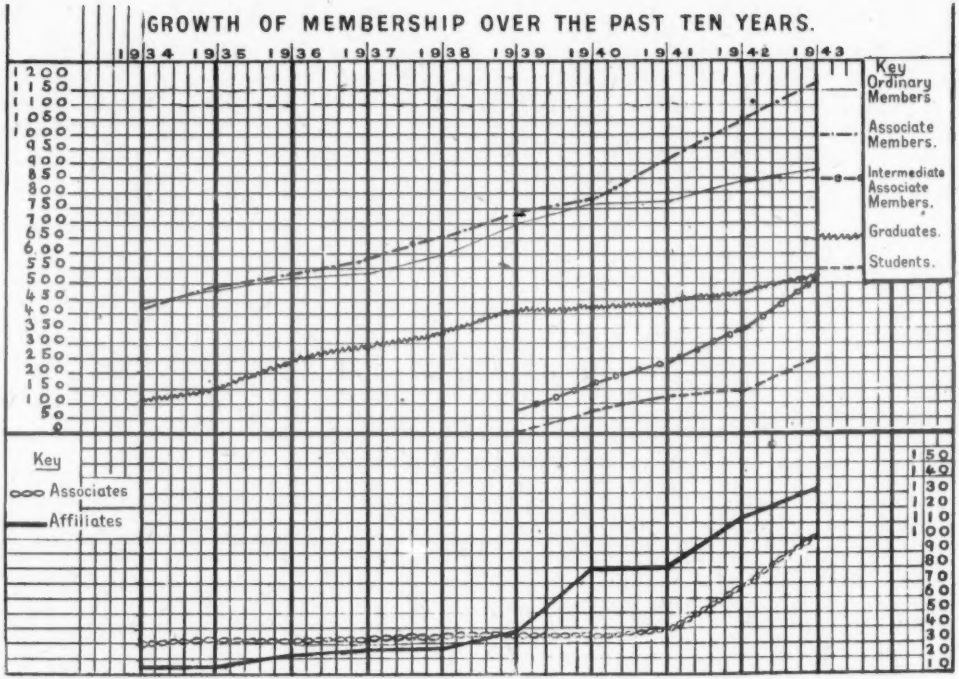
During the year 15 members have died, 12 have resigned, and 31 have lapsed. We record with regret the death of the following members : J. Bishop, A.M.I.P.E., H. F. Dalby, A.M.I.P.E., H. C. Povey, M.I.P.E., R. F. Rogers, Grad.I.P.E., B. J. Hugo, M.I.P.E., G. Marner, M.I.P.E., L. F. Redfern, Grad.I.P.E., W. C. Briggs, M.I.P.E., J. Barratt, M.I.P.E., H. F. L. Orcutt, M.I.P.E., C. R. F. Engelbach, M.I.P.E., H. McLaren, M.I.P.E., H. E. Goodman, A.M.I.P.E., R. C. Hinds, Affiliate, A. C. Burgoine, M.I.P.E.

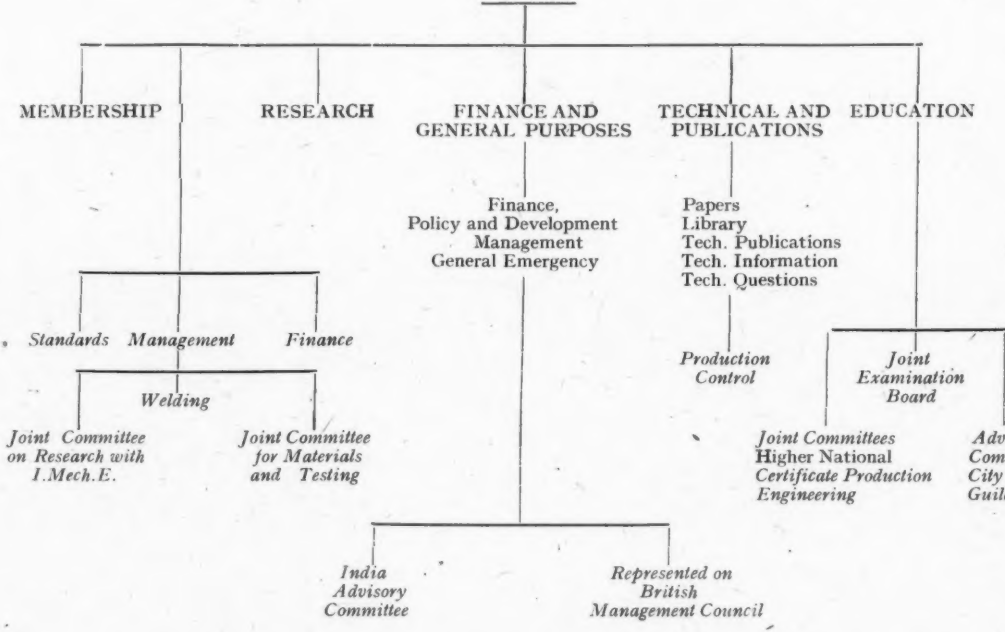
Honours Conferred on Members.

We are pleased to record that during the year His Majesty the King has conferred honours on the following members: Mr. J. Curran, C.B.E., Mr. H. S. Broom, M.B.E., Mr. H. W. Harper, M.B.E., Mr. P. B. Niekirk, M.B.E., Mr. E. J. Booth, O.B.E. Mr. E. W. Harper, O.B.E., Mr. A. N. Spriggs, O.B.E.,

Finance.

In presenting the Annual Accounts the Council again wish to draw attention to the satisfactory position of the Balance Sheet. The surplus of income over expenditure for the year was £1214.


GROWTH OF MEMBERSHIP OVER THE PAST TEN YEARS.
1934 1935 1936 1937 1938 1939 1940 1941 1942 1943
Key
Ordinary Members
Associate Members.
Intermediate Associate Members.
Graduates.
Students.
Key
Associates
Affiliates


COUNCIL
MEMBERSHIP
RESEARCH
FINANCE AND GENERAL PURPOSES
TECHNICAL AND PUBLICATIONS
EDUCATION
Finance, Policy and Development Management General Emergency
Papers Library Tech. Publications Tech. Information Tech. Questions
Standards
Management
Finance
Welding
Joint Committee on Research with I.Mech.E.
Joint Committee for Materials and Testing
Production Control
Joint Examination Board
Joint Committees Higher National Certificate Production Engineering
Advisory Committee City and Guilds
India Advisory Committee
Represented on British Management Council

Finance--Research Department.

Separate accounts including a balance sheet have been made out for the Research Department. Since, however, that department is not a separate legal entity, the relevant figures relating to it are shown in the main Institution Accounts.

Constitution of Council Committees.

During the year under review the Council have considered it appropriate to revise the constitution of the various Committees. On reference to the diagram it will be noticed that several changes have been made to the procedure previously in force.

In future there will be five Standing Committees comprising :—

(1) *The Finance and General Purposes Committee*, which is responsible for (a) Finance, (b) Development, (c) Policy, (d) Management, (e) General Emergency.

(2) *The Research Committee*, which is responsible for the administrative and Technical work of the Research Department.

(3) *The Technical and Publications Committee*, which is responsible for all the technical information submitted to the Institution for publication, the Library, the *Journal* and *Technical Bulletin*, and the work previously undertaken by the Papers Committee.

(4) *The Membership Committee*, which is responsible for dealing with all applications for Membership.

(5) *The Education Committee*, which is responsible for dealing with all applications for junior membership, and for all examination schemes.

All these Committees report direct to Council.

The Technical and Publications Committee, previously a Sub-Committee of the War Emergency Committee, now reports direct to the Council as the War Emergency Committee has been dissolved.

A new Committee has been constituted to deal with the Membership work of the Institution, and is centred in Birmingham. Previously this work was undertaken by the Finance and Development Committee.

As the Main Research Committee comprises representatives of the Institution and outside organisations, the Council decided that the Management, Finance and Standards Committees should report direct to Council.

In the case of the Sub-Committees the Council decided to make one change, and this affected the Welding Committee which now reports to the Research instead of the Technical and Publications Committee as formerly.

The members serving on these Committees are as follows:

1. *Finance and General Purposes Committee.*

H. A. Hartley (Chairman), Sir Ernest Lemon, O.B.E., J. W. Berry, J. E. Baty, J. H. Bingham, J. E. Blackshaw, J. S. Daniels, W. F. Dormer, H. J. Gibbons, G. H. Hales, F. W. Halliwell, E. J. H. Jones, R. Kirchner, Lt. Col. C. W. Mustill, J. R. Pearson, R. D. G. Ryder, the Rt. Hon. Lord Sempill, J. D. Scaife, Dr. H. Schofield, M. H. Taylor, J. G. Young.

2. *Research Standing Committee.*

J. H. Bingham (Chairman), Dr. W. Abbott, G. E. Bailey, J. E. Baty, J. H. Barber, J. W. Berry, H. Bowley, H. D. S. Burgess, G. W. Clarke, E. P. Edwards, T. Fraser, H. J. Gibbons, G. Gilfillan, G. H. Hales, M. Johnson, N. V. Kippimg, E. J. H. Jones, W. J. Morgan, J. M. Newton, J. D. Scaife, Dr. H. Schofield, Rt. Hon. Lord Sempill, Dr. S. L. Smith, M. H. Taylor, T. Thornycroft, W. E. Tipple.

Research Management Committee.

M. H. Taylor (Chairman), J. E. Baty. J. H. Bingham, H. D. S. Burgess, H. J. Gibbons, Lt. Col. Mustill, J. M. Newton, Dr. H. Schofield, T. Thornycroft, F. Williams.

Research Finance Committee.

J. H. Bingham (Chairman), H. D. S. Burgess, H. J. Gibbons, Dr. H. Schofield, F. Williams.

3. *Technical and Publications Committee.*

R. Kirchner (Chairman), B. H. Dyson, A. A. Francis, C. E. Green, H. Grigg, T. R. Kidd, A. McLeod, T. W. Price, F. B. White.

4. *Membership Committee.*

J. W. Berry (Chairman), J. H. Bingham, J. E. Blackshaw, H. D. S. Burgess, J. S. Daniels, J. W. Davies, W. F. Dormer, H. A. Drane, E. P. Edwards, F. W. Halliwell, H. A. Hartley, J. T. Kenworthy, R. Kirchner, R. D. G. Ryder, Dr. H. Schofield, F. C. White, I. H. Wright.

5. *Education Committee.*

J. W. Berry (Chairman), J. A. Boyes, J. France, J. T. Kenworthy, W. Puckey, G. H. Rutland, I. H. Wright, R. H. Youngash, E. P. Edwards, Dr. H. Schofield.

6. *Standards Committee.*

This Committee has not met since 1940, but it is anticipated that a new Committee will be appointed shortly.

Research Department Annual Report and Accounts.

The Fourth Annual Report and Accounts of the Institution's Research Department are presented separately.

Technical and Publications Committee.

War conditions have imposed changes in the composition of this Committee, but in spite of this members continue to meet weekly, and spend many hours dealing with enquiries, correspondence, articles, etc. Under the new regulations concerning the constitution of Council Committees, this Committee now reports direct to the Council. Its activities come under the following headings :

(a) To answer membership queries on all subjects connected with production engineering.

(b) To give publicity through the *Technical Bulletin* to all contributions of a suitable character within the scope of production engineering, that are received from members or other sources.

(c) To be responsible for the work of the Papers Committee, and to give publicity through the *Journal* to papers, lectures or discussions of a suitable nature.

(d) To be responsible for, and to maintain, the Library.

(e) To co-operate with the Government and other bodies with a view to assisting the national effort in the field of production engineering.

The Committee has during the year handled over 250 enquiries, which have been received from various sources. In the case of some of these enquiries it has been necessary to appoint Sub-Committees to make investigations and draw up reports. An outstanding example was an enquiry received from a Government Department on the subject of De-Skilling of Machine Setting. This report when submitted to the Ministry concerned was considered by the Department to be of such importance that a decision was taken by them to publish the report in full. The Committee have also given a great deal of time and thought to the improvement of the Institution's Journal. One of the main considerations which has engaged the minds of the Committee has been the *Journal* cover, and they hope now that this has been issued it will have the approbation of all members. Owing to the paper restriction it is not possible to maintain the high standard that existed in pre-war days, but we feel confident that our members will agree that austerity must be the rule of the day.

In March the Council reluctantly came to the decision that the *Technical Bulletin* could no longer be published in the form in which it was originally produced, and consequently the first edition of

a smaller Technical Bulletin appeared in April. Whilst the Committee will endeavour to issue this publication monthly they can only do so provided that sufficient material is available, and it is earnestly hoped that members will be prepared to co-operate by submitting articles for consideration by this Committee. We again place on record our appreciation of the time and effort put into the work by the Committee.

Educational.

By far the most outstanding subject of the year has been the Government's proposal for Post-War education. The Council are fully alive to the importance of the training of young engineers from both the practical and theoretical point of view, and are keeping in close touch with these developments.

Graduateship Examination.

It is very gratifying to report that this year a record number of candidates sat for the Institution's Graduateship examination. In all 39 applications were received from various parts of the country, and consequently it was necessary to arrange for the examination to be held in eight different centres concurrently. The Council wishes to express their thanks to the technical colleges who made such arrangements possible.

National Certificates in Production Engineering.

From the information now available we are able to report that 14 students have passed the Higher National Certificate in Production Engineering, eight of these at Southport Technical College and six at Loughborough College. Further results have yet to be received.

Production Control.

The Production Control Sub-Committee which was set up last year to co-operate with the British Standards Institution in preparing a series of Booklets on " Factory Office Systems " for the Treasury and the Ministry of Production, have now had the satisfaction of seeing their first booklet published. The absence of adequate schemes of production control, especially among the smaller engineering companies, has resulted in a great demand for information on this subject, and consequently some 16,000 copies of this booklet have now been sold. The Committee are now busily engaged on finalising Booklet No. 2, and it is hoped that this will be published in the very near future.

Welding.

The first report of the Welding Sub-Committee dealing with the Inspection of Spot Welds was published in November last, and was

acclaimed as a valuable contribution to welding from the production point of view. Owing to the reorganisation of Committees it became necessary to transfer the Welding Sub-Committee which had previously reported to the Technical and Publications Committee, to the Research Committee. and in future all reports and investigations will be submitted to the latter. The Welding Sub-Committee will shortly be resuming their activities and their attention will be devoted to the investigation of Seam Welding. It is proposed to hold these meetings in the Midlands, and investigations are now being made with a view to requesting assistance in the carrying out of tests.

Local Section Activities.

War conditions, and the consequent pressure of work on members throughout the country have inevitably curtailed the number of lecture meetings at most local Sections during the past session. In some Sections the blackout problem was met by holding meetings on Saturday afternoons and Sundays. Most Sections have, however, been able to continue to hold meetings for lectures and informal discussions, though only in a few cases has normal attendance been possible.

Lectures.

Once again the Council extend their cordial thanks to all those members and non-members who gave lectures during the year to the various Local Sections of the Institution.

New Sections.

It is always pleasing to report progress, and in this direction mention should be made of the formation of a new Section covering South Wales and Monmouthshire. The inaugural meeting was held on October 28, 1942, at Cardiff, when Lord Sempill presided at the opening and handed over the chair to Mr. A. Bailey, the newly elected President. Subsequently Mr. R. Appleby gave a paper on "Production Control" to the new Section, and the attendance numbered 200 engineers from the area. This meeting was preceded by a luncheon which included as one of the guests the Lord Mayor, who on behalf of the Corporation welcomed the formation of such an organisation in South Wales.

New Sub-Sections.

Permission has been given to the Nottingham and Manchester Sections to form Sub-Sections within their own area. The Nottingham Sub-Section will cover the Lincoln, Newark and Gainsborough area, while the Manchester Sub-Committee will cover Crewe.

Awards.

The Medal for the best paper presented by a member during last session has been awarded to Mr. R. Appleby ,A.I.P.E., London Section, for his paper on "Production Control." The Medal for the best paper given to the Institution by a non-member has been awarded to Dr. B. Dudding, M.B.E., for his paper on "Quality Control." The prize for the best paper presented to the Institution by a Graduate member has been awarded to Mr. J. H. Bailey, Grad.I.P.E., for his paper on "The operation and Tooling of Single Spindle Automatics."

Retiring Officers.

In conclusion the Council wish to express their appreciation of the services rendered to the Institution by the retiring Section Presidents, and the retiring Members of Committee. They also wish to express their gratitude for the way in which the Hon. Secretaries have carried out the secretarial work of their respective Sections, often at great inconvenience to themselves, and in thanking them for their past services the Council express the hope that they will continue to further the interests of the Institution for many years to come.

THE INSTITUTION OF PRODUCTION ENGINEERS

BALANCE SHEET AS AT 30TH JUNE, 1943

LIABILITIES.			£ s. d.
SUNDRY CREDITORS			776 5 11
SUBSCRIPTIONS RECEIVED IN ADVANCE			87 16 7
THE VISCOUNT NUFFIELD GIFT	25000 0 0		
THE LORD AUSTIN PRIZE FUND	100 0 0		
HUTCHINSON MEMORIAL FUND	40 0 0		
BUILDING AND DEVELOPMENT FUND	2156 5 0		
			27296 5 0
LEASEHOLD PREMISES SINKING FUND	635 16 8		
DILAPIDATIONS RESERVE FUND	200 0 0		
			835 16 8
INCOME AND EXPENDITURE ACCOUNT :			
Balance at 1st July, 1942	8114 13 7		
Add Investment Reserve Account	718 1 3		
	8832 14 10		
Less Re-instatement of Nuffield Gift £1000 0 0			

ASSETS.			£ s. d.
LEASEHOLD PREMISES at cost (Depreciation is provided by a Sinking Fund)			3481 0 0
FURNITURE, FITTINGS AND PLANT at cost, *less* amount written off :			
Balance at 1st July, 1942	549 12 2		
Additions during year	180 18 10		
	730 11 0		
Less amount written off	80 1 3		
			650 9 9
FUND INVESTMENTS at cost : As Scheduled (Market value £27376)			27296 5 0
GENERAL INVESTMENTS at cost : As Scheduled. (Market value £3453)			3470 0 0
SINKING FUND POLICIES : As Scheduled			835 16 8
SUNDRY DEBTORS AND DEPOSITS			857 11 5
SUBSCRIPTIONS IN ARREAR, not valued			—
CASH :			
At Bank	708 15 2		
At Post Office Savings Bank	526 7 2		

of Nuffield Gift	£1000	0	0				
					At Post Office Savings Bank	526	7 2

Addition to Lord Austin Prize Fund	47	10	0				
Addition to Hutchinson Memorial Fund	2	7	6				
				1049	17	6	
				7782	17	4	
Add Excess of Income over Expenditure for the year				1214	0	2	
						8996	17 6
RESEARCH DEPARTMENT :							
Sundry Creditors						126	1 1
Amount due to Head Office per Contra						150	0 0
Balance of Income and Expenditure Account						2848	15 6
						£41117	18 3

In Hand					16	16	6
						1251	18 10
AMOUNT DUE FROM RESEARCH DEPARTMENT per Contra						150	0 0
RESEARCH DEPARTMENT :							
Laboratory Plant and Furniture at cost, *less* amount written off						1352	8 8
Stock of Publications *not valued*							
Sundry Debtors and Payments in Advance						12	2 6
Cash at Bank and in Hand						1760	5 5
						£41117	18 3

AUDITORS' REPORT.—We have audited the above Balance Sheet dated 30th June, 1943, and we have obtained all the information and explanations we have required. The Australian Section accounts are not included in the above Balance Sheet. Subject to the foregoing, in our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Institution's affairs according to the best of our information and the explanations given us, and as shown by the books of the Institution.

Aldwych House, London, W.C.2.
6th October, 1943.

(*Signed*) GIBSON, APPLEBY, & Co., Auditors,
Chartered Accountants.

E. LEMON, *President.*

H. A. HARTLEY, *Chairman of Council and Finance Com.*

K. G. FENELON, *General Secretary and Treasurer.*

THE INSTITUTION OF PRODUCTION ENGINEERS

Income and Expenditure Account for the Year Ended 30th June, 1943

Dr.

	£	s.	d.
To Salaries	3185	7	0½
„ Rent, Lighting, Heating and Cleaning	485	12	11
„ Local Section Expenses	363	2	10½
„ Printing, Postages, Stationery and Telephone	846	18	4½
„ Cost of Journal and Bulletin	2941	19	3
„ Travelling and Expenses of Meetings other than Section Meetings	226	17	5½
„ Professional Charges and Insurances	160	2	1
„ Donations and Grants	87	6	0
„ Repairs and Renewals	100	13	5
„ Annual Luncheon	107	18	0

Cr.

	£	s.	d.	£	s.	d.
By Subscriptions received :						
Current	6338	9	8			
Arrears	501	8	10			
				6839	18	6
„ Interest on Investments				1217	4	8
„ Journal Receipts				3355	19	7
„ Contributions received for Research	2218	12	6			
„ Other Research Receipts	1786	7	8			
				4005	0	2
„ Transfer from Research Account for Management Expenses				650	0	0

,, A.R.P. Fireguard Expenses.....	117	0	0
,, Miscellaneous	63	12	10
,, Transfer to Leasehold Premises Sinking Fund	127	3	4
,, Transfer to Dilapidations Reserve Fund	100	0	0
,, Transfer to Building and Development Fund	106	5	0
,, Amount written off Furniture, Fittings and Plant	80	1	3
,, Amount transferred to Research Department Account	5754	2	11
	14854	2	9
,, Balance, being Excess of Income over Expenditure	1214	0	2
	£16068	2	11

£16068 2 11

INVESTMENTS 30th JUNE, 1943

SCHEDULE OF FUND INVESTMENTS.

	£ s. d.	£ s. d.
THE VISCOUNT NUFFIELD GIFT:		
£7269 13 8 5% Conversion Stock 1944-64...	8000 0 0	
8389 9 6 3% National Defence Stock 1954-58.....	8000 0 0	
9038 0 0 4% Canadian Pacific Railway Perpetual Consolidated Debenture Stock.....	9000 0 0	
		25000 0 0
THE LORD AUSTIN PRIZE FUND:		
£95 8 5 3½% War Stock		100 0 0
HUTCHINSON MEMORIAL FUND:		
£37 17 3 3½% War Stock		40 0 0
BUILDING AND DEVELOPMENT FUND:		
Loan to Treasury (free of interest).....	1050 0 0	
£1000 0 0 3% Defence Bonds.....	1000 0 0	
76 4 8 3½% War Stock.....	80 0 0	
Post Office Savings Bank.....	26 5 0	
		2156 5 0
Total as per Balance Sheet		£27296 5 0

SCHEDULE OF GENERAL INVESTMENTS (UNALLOCATED):

	£ s. d.
£692 13 5 2½% National War Bonds 1946-48.....	700 0 0
644 15 2 Ayr County Council 3% Redeemable Stock 1956	650 0 0
615 9 5 London County Consolidated 3% Stock 1956-61	620 0 0
595 18 2 Plymouth Corporation 3% Redeemable Stock 1956.....	600 0 0
148 3 11 3% War Stock 1955 59	150 0 0
382 13 8 3½% War Stock.....	400 0 0
190 16 11 3½% War Stock	200 0 0
95 8 5 3½% War Stock.....	100 0 0
47 9 2 3½% War Stock.....	50 0 0
Total as per Balance Sheet	£3470 0 0

SCHEDULE OF SINKING FUND POLICIES.

	£ s. d.
LEASEHOLD PREMISES SINKING FUND:	
Norwich Union Life Insurance Society Policy—Premiums Paid	635 16 8
DELAPIDATIONS RESERVE FUND:	
General Accident, Fire and Life Assurance Corporation, Ltd., Policy—Premiums Paid	200 0 0
Total as per Balance Sheet	£835 16 8

RESEARCH DEPARTMENT

Fourth Annual Report and Accounts of the Research Department for the Year Ended 30th June, 1943, presented by the Management and Finance Committees.

CONSIDERABLE progress has been made during the last 12 months. There has been an increasing number of enquiries from many sources for information and advice relating to practical production problems. The work of the Department has been limited only by lack of space and personnel.

Extension of the Research Laboratory.

The Council at its Meeting in June last gave permission to the Research Committee to proceed with extensions to the Laboratory. The plans are complete and the building will start as soon as the necessary steel is released. The Council wish to place on record their sincere appreciation of the assistance which has been received from the Governors of Loughborough College in granting the necessary facilities and for preparing the plans.

Research Work.

The activities of the Department during the past year have been in general conformity with the Research Plan published with the last year's Annual Report. They include :—

1. *Surface Finish.* Research on this subject has been very extensive though it is still in its infancy. It is likely to have a vital influence particularly on mating surfaces in the manufacture and performance of nearly all precision products. Surface finish is also important where parts are highly stressed. Investigations into surface finish have therefore been concerned, firstly, with the degree of roughness permissible on certain components, and secondly, with the conditions necessary to achieve the required finish in production. The Department has investigated the finish of many components including aircraft parts, fuel injector parts, submersible pumps and the like. It has been particularly concerned with the conditions which must be satisfied by the machine and cutting tool (or grinding wheel) if satisfactory finish on the product is to be achieved. The Department has found it necessary to device means for measuring the surface finish of work while it is still in the machine. Surface finish measurement of the product is frequently

the most satisfactory method of assessing the performance of cutting tools and finishing operations.

2. *Cutting Tool Investigations.* A great deal of work has been done on various types and grades of cutting tools, including diamonds, cemented carbide, high speed steel, substitute steels ("66" and "46"), and the researches have been generally on turning, boring, drilling, milling and grinding. In all these investigations special attention has been paid to cutting lubricants. These investigations involve the measurement and control of the following factors :—

(a) The material being cut.
(b) The tool—its material, finish, angles and rigidity.
(c) Speeds, feeds and depth of cut.
(d) The condition of machine tool, including questions of rigidity and vibration.

In order to accomplish this work the Department has had to design and make, or acquire from outside, a comprehensive range of special devices, including dynamometers for measuring the forces in all directions exerted by cutting tools and drills in operation. Reports on these investigations are being prepared for publication.

Special Researches.

The Department has made a number of special researches, for example : The determination of the most suitable tool design and cutting conditions for (a) machining of de-oxidised and tough pitch copper, (b) the turning of special alloy steels, (c) the finish machining of certain alloy die castings.

It has also undertaken numerous special investigations at the request of Government Departments and private firms.

Equipment.

In order to carry out its work much additional plant has been made available. Particular reference should be made to :—

(1) 32 in. swing (60 h.p.) centre lathe
(2) Diamond turning lathe
(3) Fine boring machine
(4) Universal tool grinder
(5) Twist drill grinder
(6) Two drilling machines specially adapted for our research
(7) High speed routing machine
(8) Production milling machine
(9) Power hack saw
(10) Testing machine

(11) Hardness tester
(12) Vibrograph
(13) Modern electrical switchboard for the distribution of power supply

Other machines available for occasional use in Loughborough College.

Joint Committee with Diamond Die and Tool Panel.

A Joint Committee of this Panel and the Management Committee of the Research Department has been formed to deal with investigations into diamond cutting tools. Several meetings have been held and tests concerned with diamond tools are being undertaken by the Department.

British Standards Institution.

Representatives and Members of the Staff of the Department are serving on various Committees of the British Standards Institution. Meetings have been attended to deal with the preparation of Standards on the following subjects :—

Surface roughness, and
Nomenclature of cutting tools.

Publications.

(*a*) *Machine Tool Tests and Alignments.*

(1) Planer, (2) Shaper, (3) Slotter, (4) Tool room lathe, (5) Lathe from 16 to 32 in. swing, (6) Facing lathes, (7) Relieving lathe, (8) Vertical drilling machine, (9) Spur gear shaper, (10) Helical gear shaper, and (11) Worm hobbing machines.

The above charts are being prepared for publication.

(*b*) *Surface Finish.*

Last year the Institution entered into an agreement with the American Society of Mechanical Engineers for them to publish an American edition of the Department's Report on Surface Finish. Up to the end of June last, 585 American copies had been sold. To date 1300 copies of the English edition have been issued.

Department of Scientific and Industrial Research.

The Management Committee has been aware for some time that final recognition of the Research Department by the Department of Scientific and Industrial Research would facilitate the further development of the Department, and it will therefore be re-opening discussions in the near future.

Committees.

The supervision of the work of the Department has made it necessary for the Management and Finance Committees to meet monthly at Loughborough from Sunday afternoon to Monday evening.

Staff.

The staff of the Department numbers eleven, consisting of the following persons: Dr. Schlesinger (Director), Dr. Galloway (Assistant Director), Messrs. Morton, Holmes, Pringsheim, Wood (Research workers) ; Messrs Chamberlain, Spencer, Taylor (Mechanics) ; Mrs. Albery (Technical Assistant) ; Miss Barradell (Secretary). During the year, Mr. Galloway was awarded the Degree of Ph.D., by the University of London for his thesis on " Fine Finish Turning of Non-Ferrous Alloys."

Three members of the staff are at present working for higher degrees and it is gratifying to record that the University of Edinburgh has recognised the standing of the Department by permitting research undertaken in the Department to qualify for the degree under their Ph.D. regulations.

The Council wish to record their high appreciation of the services of the Director and his staff. It is due to their enthusiasm and zeal that the work of the Department has been so successfully carried on during the year.

Income.

Appended is a list of affiliated firms and others who have contributed to the general funds of the Department during the financial year ended June 30, 1943. These contributions have been received though the Institution has made no specific appeal during the current year, and the Council wish to record their appreciation of the generous financial support referred to above, and also to the following for the gift or loan of equipment provided for the Department's use.

Machines provided by :

Messrs. Bryant Symons & Co. Ltd., London (Diamond turning lathe).

Messrs. Cooke & Ferguson, Ltd., Manchester (Fabricated milling machine).

H. C. Holmes, Esq., (Colchester lathe).

Messrs. John Lund, Ltd., Keighley (Fine boring machine).

Ministry of Supply [32 in. swing (60 h.p.) centre lathe].

Messrs. Taylor, Taylor & Hobson, Ltd., Leicester (Talysurf).

Messrs. Wadkins Ltd., Leicester (Routing machine).

The Council again wishes to thank the Governors and Principal of the Loughborough College for the use of the Laboratory without charge, and all those who have assisted in the work of the Department.

Subscribers to the Work of the Research Department.

	£	s.	d.
Norman Davis		10	6
British Thomson-Houston Co. Ltd.	25	0	0
Stephen L. Harnett	1	1	0
W. H. Lowe and F. H. Schofield		10	6
Clarkson (Engineers) Ltd.	5	5	0
Boulton Paul Aircraft Ltd.	25	0	0
Edward Pryor & Sons	20	0	0
Howard Wall Ltd.	10	10	0
A. Goldman	20	0	0
S. & S. Precision Tools Co.	5	5	0
B. S. Lewis	1	0	0
R. J. Fraser		10	0
Ruston Bucyrus	50	0	0
A. E. Judd	2	0	0
Deloro Smelting & Refining Co. Ltd.	50	0	0
Gauge and Tool Makers' Association	52	10	0
Aladdin Industries Ltd.	25	0	0
T. H. & J. Daniels Ltd.	25	0	0
British Northrop Loom Co. Ltd.	10	0	0
Hepworth & Grandage Ltd.	25	0	0
Wallace & Tiernan Ltd.	5	5	0
Leyland Motors Ltd.	100	0	0
B.S.A. Tools Ltd.	25	0	0
Murex Ltd.	20	0	0
J. E. Baty & Co. Ltd.	26	5	0
Albion Motors Ltd.	50	0	0
Associated Equipment Co. Ltd.	100	0	0
G. D. Peters & Co.	50	0	0
Vauxhall Motors Ltd.	250	0	0
Dennis Bros. Ltd.	25	0	0
Reavell & Co. Ltd.	26	5	0
Adamant Eng. Co. Ltd.	26	5	0
Humber Ltd.	50	0	0
Holman Bros. Ltd.	25	0	0
W. Asquith Ltd.	26	5	0
Hobbies Ltd.	10	10	0
George Kent Ltd.	25	0	0
Hoover Ltd.	100	0	0
Ferranti Ltd.	52	10	0

	£	s.	d.
Thomas Ryder & Son	20	0	0
John Lund Ltd.	26	5	0
Pressed Steel Ltd.	100	0	0
H. M. Hobson Components Ltd.	21	0	0
Cocksedge & Co. Ltd.	10	0	0
Standard Telephones and Cables Ltd.	100	0	0
G. Beaton & Sons Ltd.	10	10	0
Brush Electrical Engineering Co. Ltd.	25	0	0
Hayward Tyler	21	0	0
Cutanit Ltd.	50	0	0
Fred Gilbert (Cardiff Ltd.)	5	0	0
George Bray & Co. Ltd.	50	0	0
Vickers-Armstrong Ltd. (Bath)	250	0	0
E.M.B. Co. Ltd.	10	0	0
Newton Chambers & Co. Ltd.	100	0	0
A. C. Wickman Ltd.	26	5	0
Jackson Boilers Ltd.	5	5	0
L. G. Archer		10	6
Climax Rock Drill and Engineering Co. Ltd. ...	50	0	0
W. A. Cook		5	0
E. J. Ring		5	0
	£2228	12	6

THE INSTITUTION OF PRODUCTION ENGINEERS

RESEARCH DEPARTMENT

DR. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30TH JUNE, 1943 CR.

	£	s.	d.		£	s.	d.
To Salaries and Wages	3864	12	8	By Grant from Institution Funds	1749	2	9
,, Management Expenses	650	0	0	,, Transfer from the Institution of amounts received for Research:			
,, Rent, Lighting, Heating and Cleaning	32	7	8	Contributions 2218 12 6			
,, Printing, Postages, Stationery and Telephone	127	3	10	Bank and Post Office Interest 9 10 9			
,, Travelling and Expenses of Meetings	86	2	9	Research Receipts..... 1430 8 9			
,, Professional Charges and Insurances	85	14	8	Sale of Technical Publications 243 6 4			
,, Technical Publications				Royalty on Publications 103 1 10			
,, Laboratory Materials	423	10	3		4005	0	2
,, Repairs and Renewals to Plant and Equipment	23	12	7				
,, Miscellaneous	23	17	8				
,, Income Tax on Deposit Interest	1	15	0				
,, Depreciation: Plant and Equipment 276 16 3; Office Furniture 4 16 9	281	13	0				
	5600	10	1				
,, Balance, being Excess of Income over Expenditure	153	12	10				
	£5754	2	11		£5754	2	11

THE INSTITUTION OF PRODUCTION ENGINEERS

RESEARCH DEPARTMENT

BALANCE SHEET AS AT 30TH JUNE, 1943

LIABILITIES.			£ s. d.	ASSETS.			£ s. d.
SUNDRY CREDITORS			126 1 1	PLANT AND EQUIPMENT at cost *less* amount written off:			
HEAD OFFICE			150 0 0	Balance at 1st July, 1942		1178 10 1	
INCOME AND EXPENDITURE ACCOUNT:				Additions during year ...		436 4 10	
Balance at 1st July, 1942	2695 2 8					1614 14 11	
Add Excess of Income over Expenditure for the year	153 12 10			*Less* Depreciation		276 16 3	
		2848 15 6					1337 18 8
				OFFICE FURNITURE at cost, *less* amount written off:			
				Balance at 1st July, 1942		18 8 0	
				Additions during year ...		18 9	
						19 6 9	
				Less Depreciation		4 16 9	
							14 10 0
				STOCK OF PUBLICATIONS			

				14	10	0

STOCK OF PUBLICATIONS *not valued*				—		
SUNDRY DEBTORS AND PAYMENTS IN ADVANCE				12	2	6
CASH :						
At Bank	707	19	5			
Deposit Account : Bank	450	0	0			
Deposit Account : Post Office	507	5	10			
Petty Cash : Bank	87	3	6			
Petty Cash : In Hand ...	7	16	8			
				1760	5	5
				£3124	16	7

AUDITORS' REPORT.—We have audited the above Balance Sheet of the Institution of Production Engineers' Research Department dated the 30th June, 1943, and we have obtained all the information and explanations we have required. In our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Department's affairs according to the best of our information and the explanations given us and as shown by the Books of the Department.

Aldwych House, London, W.C.2.
6th October, 1943.

(*Signed*) GIBSON, APPLEBY & Co., AUDITORS,
Chartered Accountants.

E. LEMON,
President of the Institution.

J. H. BINGHAM,
Chairman, Research Committee.

K. G. FENELON,
General Secretary and Treasurer of the Institution.

Research Department: Production Engineering Abstracts

(Edited by the Director of Research)

NOTE.—*The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.*

COMBUSTION, FURNACE.

The Uses of Controlled Atmospheres in the Metal Industries. (*Sheet Metal Industries, September, 1943, Vol. 18, No. 197, p. 1535, 7 figs.*).

Part I—Introduction. Development of controlled atmospheres. Advances in furnace design. The electric furnace. Surface films. The process of oxidation. Advantages of controlled atmospheres. Uses of controlled atmospheres.

ELECTRICITY, ELECTRICAL ENGINEERING.

Wave Guides in Electrical Communication, by J. Kemp. (*Jnl. of the Institution of Electrical Engineers, September, 1943, Vol. 90, Part III, No. 11, p. 90, 39 figs.*).

The salient properties of electromagnetic waves in hollow metal tubes are described and the extent to which the theory of the subject had its origin in the researches of Lord Rayleigh and others who during the closing years of the last century worked in Great Britain. The present development of the theory and its practical application are due to researches carried out during recent years, mainly, in the United States. A systematic account is given of the development of elementary equipment appropriate to hollow-tube transmission with analogies from accoustics, telephony, and radio engineering. Phenomena observed at the open ends of guides—flared or unflared—and the efficiency of these devices as radiators of energy into free space are dealt with.

Amplifying and Recording Technique in Electro-Biology, with Special Reference to the Electrical Activity of the Human Brain, by G. Parr. (*The Institution of Electrical Engineers, September, 1943, Vol. 90, Part III, No. 11, p. 129, 20 figs.*).

The production of an e.m.f. is one of the fundamental properties of the living cell and owing to the nature and magnitude of this e.m.f. special amplifying methods and input circuits are required. The paper reviews the standard methods of amplifying and recording biological potentials, and the application of these methods to recording the electro-encephalogram, or the record of potentials developed in the human cerebral cortex. The magnitude of the potentials produced by the brain varies between 5 and 1,000 μ-V, the wave form being alternating, irregular and of very low frequency. The frequency of the output from an abnormal brain (e.g. epileptics and cerebral tumours) differs appreciably from that of the normal, and from this and other indications it is possible to diagnose mental diseases and locate with considerable accuracy the site of tumours. Apparatus developed for analysing waves of low frequencies (1-20c/s) on the mechanical resonance principle is described.

FOUNDRY, MELTING, MOULDING, PATTERNS.

The Production of Malleable Iron Castings, by J. Roxburgh, (*Engineering, September 17, 1943, Vol. 156, No. 4053, p. 236, 7 figs.*).

Certain aspects of the practice in foundries are given with description and illustration of the manufacture of particular castings. Moulding sands. Synthetic sands. Bentonite substitute. Metal behaviour during cooling provides a reservoir of hot metal from which the casting can draw to fill up the cavities or unsound portions which would otherwise result. Gating malleable castings. Spherical-shaped feeders. Floor and bench castings. Machine moulding. Jolt-squeeze machines. Jolt roll-over machines.

MACHINE ELEMENTS.

Annular Ball-Bearings—I, by R. Waring-Brown. (*Power Transmission, September 15, 1943, Vol. 12, No. 140, p. 542, 7 figs.*).

Rolling friction. Design in reference to friction. Rolling motion in ball bearings. Three-point angular contact ball bearing. Angular contact ball bearing. Two-point contact ball bearings. Design in reference to load. Metal flow under compression. Load and ball size. Load and ball race track form. Ball race track forms.

MACHINE TOOLS, MACHINING.

Spindle Bearings for Machine Tools, by G. Schlesinger. (*Machinery, September 2, 1943, September 9, 1943, September 23, 1943, Vol. 63, Nos. 1612, 1613, 1615, pp. 267, 296, 348, 27 figs.*).

Partially slit bearings adjusted by press-screws. Mackensen bearing with 3-line support. Mackensen bearing with 3-surface support. Churchill plain bearing, self-adjusted by hydraulic pressure. Internal grinding spindle (20,000 r.p.m.) with plain front bearing of hardened steel. Spindle bearings of (a) 35 h.p. vertical drilling machine, (b) high speed 5,000 r.p.m. vertical milling machine. Front taper bearing with thrust washer. Taper front bearing. The axial thrust is taken up by ball bearing. Headstock of Oerlikon heavy lathe for 3 to 950 r.p.m. Taper front bearing with two ball thrust bearings. Plain bearing with fine adjustment by worm, worm-wheel and thread for heavy milling machine. Turret lathe taper bearing with bronze bushing pressed on spindle which runs in an external bushing of hardened steel which is axially adjustable. Plain spindle of 20 h.p. vertical grinder. Taper front bearing, and plain roller rear bearing, with ball thrust bearings in front and rear. Petermann-Moutier automatic turret lathe, 6,000 r.p.m. with two ball bearings in front, one locating bearing, and with deep shoulder at rear. Headstock of M.W.F. Magdeburg lathe, with spindle in plain bearings and ball and roller bearings for all secondary shafts. Rear roller bearing, spherical front bearing, self-adjusting and pre-loaded. Main spindle of milling machine provided with Timken double bearings at front and rear.

Taper roller bearing with single rows of rollers in front and rear. Cylindrical roller bearings, adjustable at front by internal taper race. Taper roller bearings for gear box and main spindle of Cincinnati vertical milling machine. Headstock of Monarch Lathe equipped with Timken bearings. Ball bearing spindles of Pittler multiple spindle turret lathe. Spindle of an internal grinder with single-race ball bearings, 60,000 r.p.m. Needle bearing requiring the smallest construction space for high speed automatic screw machine. Section through "Nomy" bearing loaded radially with self-adjusting oscillating blocks. Section through "Filmatic" bearing of Cincinnati grinder. Filmatic bearing with pressure interlock.

Types of Milling Machines. (*The Machinist, September 25, 1943, Vol. 87, No. 23, p. 106, 14 figs.*).

Plain milling machine. Universal hand vertical milling machine. Automatic bed-type. Milling cutters. Attachments. Setting up the job. Clamping the work. Vices as holding devices. Lining up the job. The use of fixtures. Mounting the cutters. Locating the cutters. Speeds and feeds. Table of cutting speeds. Tips for operators.

Industrial Metal Finishing, by H. Silman. (*Sheet Metal Industries, September, 1943, Vol. 18, No. 197, p. 1567, 14 figs.*).

Part III. Polishing processes. The methods in use are : (a) burnishing, (b) polishing with abrasives, using flexible wheels, belts, discs, etc., (c) barrel polishing or rumbling, (d) electrolytic polishing. Polishing on lathes. Automatic polishing. Advantages and disadvantages of automatic buffing. Polishing wheels. Buffing wheels. Abrasives and their application. Setting up of wheels. Drying. Polishing compositions.

CHIPLESS FORMING.

Two-Stage Drawing of Cylindrical Cups, by Prof. H. W. Swift. (*Sheet Metal Industries, September, 1943, Vol. 18, No. 197, 1547, 9 figs.*).

Stresses and loads in the initial draw. (A) Cupping : (i) non-hardening material, (ii) constant strain-hardening rate with yield. (B) Radial drawing : (i) non-hardening material, (ii) constant strain-hardening rate following yield, (iii) parabolic strain-hardening without initial yield. Stresses during drawing-down period of redrawing operation : (a) flat die surface with strain hardening, (b) conical die without strain-hardening. (c) conical die with strain-hardening. Thickness changes during drawing : (a) radial drawing from a blank, (b) drawing down period of redraw, (c) drawing-in period of redraw.

Plastic Reduces Cost of Piercing Dies, by R. Kennedy. (*The Machinist, September 18, 1943, Vol. 87, No. 22, p. 83, 8 figs.*).

Holes may be punched in sheet-metal parts by tools which can be produced quickly and cheaply, and are easily handled by women. Punch dimensions in inches. Punch clearances for the die plate.

MANUFACTURING METHODS.

Mass Production of Press-Formed Parts, by R. Dewert. (*Sheet Metal Industries, September, 1943, Vol. 18, No. 197, p. 1583, 12 figs.*).

Reference is made to the progress achieved in the mass production of small formed parts ; chromium plating of the tools, accurate heat treatment, and special hardness machines. The suitability of forming processes to the production of high-grade articles at low cost.

Precision Thread Rolling, by D. Bailey. (*Machinery, September 16, 1943, Vol. 63, No. 1614, p. 309, 14 figs.*).

Yields are over 100,000 studs per set of dies on modern centreless thread-generating machines. Reciprocating thread rolling machine. Pair of dies for rolling machine screw threads. Standard depth dies. Filler plates at bottom only. Standard dies set up for special work. Photomicrograph showing deformation of thread crest due to downward thrust of stud. Photomicrograph of thread section showing lap in flank of thread due to incorrect die setting. Centreless thread generating machine. Types of cir-

cular dies or rolls. Various sizes of precision studs rolled in quantity production work from S.69 steel with diameters held within 0.0015 in. limits: showing studs before and after rolling, and indicating flow of metal.

Broach Rifling Machine Gun Barrels, by W. Baumbeck. (*Machinery, September 9, 1943, Vol. 63, No. 1613, p. 290, 2 figs.*).

In 1918 an experienced operator was capable of rifling about six 0.30 calibre rifle barrels in 1 hour by the conventional rifling method. Today by means of a modern broaching machine and special broaches, an operator is able to rifle 40 similar barrels in the same length of time. The rifling consists of four grooves approximately 0.004 in. deep and 0.171 in. wide, machined in the bore to form a spiral making one turn in 10 in. Principle of operation in modern compound broach rifling. Working details. Method of lubrication. Comparison of broach rifling, and conventional rifling, based on rate of 40 barrels per hour.

Radial Drill Press Operations—XV, XVI. (*The Machinist, Reference Book Sheet, September 11, 1943, Vol. 87, No. 21, p. 129*).

Synthesis—each piece time. Table—time to counterbore various materials. Table—time to countersink various materials.

The Horsa Glider, by Wilfred E. Goff. (*Aircraft Production, October, 1943, Vol. V, No. 60, p. 464, 25 figs.*).

Part I. Airspeed troop-carrier in production. Building the fuselage.

Practical Aspects of Machine Production and Surface Finish as They are Related to Tool Wear, by J. T. Beard. (*The Tool Engineer (U.S.A.), August, 1943, Vol. 12, No. 8, p. 69, 15 figs.*).

Cutting pressures. Rubbing speeds. The built-up edge. Functions of a cutting oil. Methods of application. Characteristics of cutting oils. Selection of a cutting oil. Practical suggestions. Examination of tool wear.

Large Radii Cut Without Special Tools, by Earl D. Rochrock. (*The Machinist, September 4, 1943, Vol. 87, No. 20, p. 96, 5 figs.*).

Advantages of this method. A huge time saving. Set-up requires only 10% to 25% of the time a swinging device needs, while the actual running time is reduced as much as a half to a third. Also, as it is only necessary to remove the toolbit and sharpen it, the longer time and the equipment needed to grind any formed cutter is saved. Expensive form cutters are dispensed with. The holding fixtures are simple and inexpensive and replace cumbersome costly, swing fixtures. One essential advantage lies in its flexibility as the range of radii to which it can be adapted is unlimited.

MATERIALS, MATERIAL TESTING.

The Strain Ageing of Killed Low-Carbon Steel, with Particular Reference to the Effect of Titanium, by G. F. Comstock. (*Sheet Metal Industries, September, 1943, Vol. 18, No. 197, p. 1527, 1 fig.*).

The strain-ageing of heat-treated specimens cut from forged bars of killed low-carbon steel melted in a small induction furnace was studied by six methods including comparison of the yield point, and noting the changes in impact value, hardness, and damping capacity on ageing after straining.

Titanium if present to the extent of at least 4.5 times the carbon content was effective in preventing strain-ageing as determined by all the methods. Such steel does not have a real yield point whether normalised, annealed, or strained and aged.

Elevated Temperature Ageing of 24 S Aluminium Alloy, by P. P. Mosley and J. Aeron. (*Science (U.S.A.), Vol. 10, No. 6, June, 1943, p. 180*).

The ageing of strong Al alloys at elevated temperatures is not a new process and the possible improvements in physical properties have been frequently studied.

The fear of corrosion difficulties and lack of precise data on the heat treatment have delayed application of the process.

For this reason the author carried out detailed tests on 24 S alloy as commonly employed in aircraft construction. It appears that optimum results are obtained for this alloy when ageing at 375°F. for 8 hours. This treatment will raise the yield point by about 50% and the ultimate tensile by 10%, whilst the original elongation is approximately halved.

The maximum physical properties obtainable by ageing depend to a considerable extent on the inherent stress distribution due to cold working after solution heat treatment but prior to ageing. For consistent results the amount of cold working should correspond approximately to that required to produce a 1% permanent set by stretching or 2% reduction in thickness by rolling.

The corrosion resistance of aluminium covered sheet of 24S alloy is not seriously affected by the ageing at elevated temperature, provided the thickness of the sheet is greater than .032 in.

The corrosion resistance of bare 24 S alloy is however appreciably lowered and elevated temperature ageing in thicknesses below $^{3}/_{16}$ in. is not recommended because of the increased tendency of inter-crystalline corrosion.

It will thus be noted that hot temperature ageing of 24 S alloy presents important advantages without any risks of excessive corrosion. The only drawback is the need for a close control of the degree of prior cold-working if consistent results are to be obtained.

(*Communicated by D.S.R. Ministry of Aircraft Production*).

Theory of the Expanding of Boiler and Condenser Tube Joints Through Rolling, by A. Nadai. [*A.S.M.E., (U.S.A.), Preprint, April 26, 1943*].

Tubes in industrial water heaters, steam boilers, and condensers of turbines are fitted in the holes of adjoining drums or head plates by expanding the tube ends. These are slightly enlarged by means of small revolving rolls. In one large steam condenser many thousands of such tube joints have to be rolled, and in high-pressure boilers these joints must remain tight under several thousands of pounds pressure at high temperatures. The pressure of the revolving rolls creates a radial plastic distribution of stress in the tube wall and around the hole in the adjoining heavy steel plate. After the tube end has been rolled, a system of residual stresses remains locked up near the joints which is essential for its pressure tightness. These plastic states of stress have been investigated for various types of the stress-strain characteristics of the tube metal and steel of the head plates. Simple rules are used for computing the stresses in a moderately thick-walled tube under external and internal pressure, either in the elastic or in the plastic state of stress.

(*Communicated by D.S.R. Ministry of Aircraft Production*).

MEASURING METHODS.

Shrink Fit Tolerances—I. (*The Machinist, September 25, 1943, Vol. 87, No. 23, p. 142E.*).

A survey is given of the negative clearances used by leading American manufacturers in the design of shrink fits of various types including data on the shrinkage obtained through chilling.

Surface Finish Designations. (*The Tool Engineer (U.S.A.), Production Data Sheet, August, 1943, Vol. 12, No. 8, p. 97, 1 fig.*).

(1) finished surfaces; (2) special purpose surfaces.

PLASTICS, POWDER METALLURGY.

Metallizing Plastics, by E. E. Halls. (*Plastics, June, July, August, 1943, Vol. 7, No. 73—75, pp. 235, 281, 337. In progress*).

The first three parts of a series of articles which will describe all the methods of coating plastics with metals: metallic paints consisting of Al and other metal powders in a varnish or lacquer medium; modifications to produce good electrical conducting properties in the films of metal powder in lacquer or varnish; sprayed metal coatings.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Laminated Fabric-resin Plastics for Bearings, by W. A. Cook. (*Machinery, September 16, 1943, Vol. 63, No. 1614, p. 322, 9 figs.*).

Texolex laminated plastics, made of fabric bonded and impregnated with synthetic resin of the phenol-formaldehyde type, have been developed in special grades of this material suitable to various types of bearing, prominent among which are rolling mill bearings and stern shaft bearings for sea and river vessels. Hydraulic pumps, conveyors operating in water, water valve bearings and seatings, pistons and other machinery. Selection of laminated bearings. Designs of fabric bearings. Coefficient of friction for Texolex M.B. bearings. Seizure conditions with water and emulsion. Seizure conditions for dry running. Properties of Texolex tubular or moulded laminated fabric bearing material; tensile strength; cross breaking strength; compressive strength—radial and longitudinal; shear strength—across layers and along layers; impact strength; Young's modulus; weight; Brinell hardness number; Sclerescope number.

Powder Metallurgy and its Relation to the Electroplating Industry, by J. F. Kuzmick. (*Amer. Electroplaters' Soc., 31st Annual Convention Paper (Typescript), April, 1943, p. 4*).

Metal powders can be prepared by electrolytic methods, and powder-metallurgy products are plated with other metals for protection, to cover porosity, and for other purposes.

(*Communicated by the British Non-Ferrous Metals Research Association*).

A Course in Powder Metallurgy, by Walter J. Baëza. (*212 pages, Reinhold Publishing Corporation, New York, 1943, $2.34*). Book Review.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Powder Metallurgy: Physical (Mechanical) Properties of Parts Made from Iron Powder, by F. V. Lenel. (*Mech. Eng. (U.S.A.), July, 1943, Vol. 65, No. 7, p. 489; Metallurgia, August, 1943, Vol. 28, p. 166, p. 189.*)

American manufacturers have been considering the preparation of specifications for iron parts made from metal powders and recommend that

general specifications should give chemical composition and density requirements, and not tensile properties since these latter vary according to size and shape of part and a number of other factors. Specifications for particular parts may give requirements for shock resistance and hardness.

(*Communicated by the British Non-Ferrous Metals Research Association*).

SHOP ADMINISTRATION AND MANAGEMENT.

Organisation of the Drawing Office, by A. J. Strachan. (*The Commonwealth Engineer, June 1, 1943, Vol. 30, No. 11, p. 265, 2 figs.*).

Space. Lighting. Ventilation. Equipment. Storage. Staffing. The system of operation for the production of drawings. Standard sizes of drawing sheets. Drawing titles. Registration of drawings. Indexing of drawings. The issue of drawings. Issue of catalogues, technical data, etc. Drawing office routine. Checking of drawings. Tracing. Alteration to drawings.

SMALL TOOLS.

Vitrified Diamond Grinding Wheels. (*Industrial Diamond Review, October, 1943, 35th Issue, Vol. 3, p. 55*).

Nearly all attempts in recent years to produce bonded diamond wheels excluded the vitrified or ceramic bond, and utilised processes whereby the diamond grain was bound in other substances, such as phenol-resin, metal powders, etc. American, British and Swiss patent specifications are quoted, which bind diamond in vitrified wheels by varying the ordinary practice in such a way that firing cannot damage the diamond grain. Examples of the compositions calculated for the abrasive periphery involving the use of silicon, etc., are given.

SURFACE, SURFACE TREATMENT.

Sprayed Metal Reduces Maintenance Costs, by B. Granowski. (*The Australasian Engineer, June 8, 1943, Vol. 43, No. 325, p. 16, 8 figs.*).

Metal spraying, while in use before the world war, is only now being recognized as an important advancement in industrial technique. By using this process, a metal unable to withstand a certain corrosive may be given a coating of another metal that will withstand the chemical and thus protect the base metal of which the equipment is built. Parts subjected to conditions which cause excessive wear may be built up to their original size and thus eliminate the necessity of purchasing new parts.

Examples : (1) Journal ground to size after spraying. (2) Metallising worn 16 in. diameter journal of heavy duty roller $^{3}/_{16}$ in. on diameter with high carbon chrome manganese steel. (3) Spraying inside of high pressure hydraulic sleeve with $\frac{1}{4}$ in. phosphor bronze. (4) Crankshaft being sprayed with high carbon chrome manganese steel. (5) Metallising badly worn tailshaft sleeve 17 in. dia. with phosphor bronze. (6) Hydraulic ram 23 in. dia. × 4 ft. 6 in. long, metallised with $\frac{1}{8}$ in. thickness phosphor bronze. Wearing quality of sprayed surface. Grinding and machining metal-sprayed surfaces. Bond strength. Microstructure of the deposit.

Finishes for Plywood in the Aircraft Industry (Types and Application), by R. B. Anderson. (*A.S.M.E. (U.S.A.), Preprint, April 26, 1943*).

The major requirements of a finishing system of the direct coating type for plywood aircraft surfaces are presented. These include moisture resist-

ance, durability to weathering and hard usage, weight factors, application in the airplane factory, refinishing in the field, and the need for film smoothness. A review of the various types of finishes is given covering both the development and service stages. These types can be classified as : (a) Cellulose, (b) alkyd, (c) phenolic, of these, the phenolic type appears to be the most promising.

The cellulose type is easy to apply and dries quickly. It has however, a poor moisture resistance and tends to crack and is considered unsatisfactory by the author.

Alkyd type finishes are relatively new and more experience in the field will be required before a definite judgment can be passed. Its moisture resistance appears however, to be inadequate. The methods of finish applications are considered together with some of the precautions which must be considered.

(*Communicated by D.S.R. Ministry of Aircraft Production*).

Metal Cleaning Solutions, by Dr. R. W. Mitchell and Marcel T. Zinty. (*The Machinist, September 4, 1943, Vol. 87, No. 20, p. 105, 5 figs.*).

They can be grouped into four major classifications :

(1) Alkaline cleaners. (2) Solvent cleaners. (3) Petroleum spirit cleaners. (4) Emulsifiable cleaners.

Simple Cleaning Tanks for Small-Lot Metal Washing, by Dr. R. W. Mitchell. (*The Machinist, September 18, 1943, Vol. 87, No. 22, p. 94, 6 figs.*).

Correctly designed steam-heated tank. Methods of agitating solutions. Methods of heating solutions. Tank dams or skimming. Troughs. Cleaning and ventilating tanks. Spray washing and rinsing machine.

TECHNICAL EDUCATION.

Engineering Economics, by Sir F. Gill. (*Jnl. of the Institution of Electrical Engineers, September, 1943, Vol. 90, Part 1, No. 33, p. 373, 5 figs.*).

The object of this paper is to try to give further impetus to the teaching of engineering economics in the universities and schools to every engineering student, to give to teachers in the schools some idea of what practising engineers mean by " engineering economics," to show the importance of the subject and how readily a knowledge of it can be taught, and to set out in an orderly manner one form in which estimates may be made and summaries presented for final judgment. Contents : some definitions, the mechanism of engineering economics, preliminary examples, some specific examples, how should engineering economics be taught, conclusion, references.

WELDING, BRAZING, SOLDERING.

Arc Welding Faults and Corrections—I and II, by C. H. Jennings. (*The Machinist-Reference Book Sheet, September 25, 1943, Vol. 87, No. 23, p. 129, 9 figs.*).

Complete fusion. Poor fusion and inclusions. Porous butt weld. Incomplete penetration. Ductile and brittle joints. Arc blow at end of joint. Shunt controls arc blow. Undercut and good fillet welds. Angular distortion of improperly prepared joint. Proper clamping avoids distortion.

Welding of Metals with Bronze. (*The Commonwealth Engineer, May 1, 1943, Vol. 30, No. 10, p. 231, 5 figs.*).

Bronze welding may be employed for the welding of wrought iron, cast iron, carbon and alloy steels, malleable cast irons and, in general, the majority

of metals and alloys having a melting point which is higher than that of the applied bronze. Its economical advantages have caused the process to be widely used in engineering practice for joining small steel parts and fractured articles, building up broken gear teeth, etc. Fusion welding. Non-fusion welding. Process of welding : (1) preparation of the work. (2) preheating. (3) tinning the base metal. (4) building up the joint. (5) After treatment. Applications. Missing gear tooth built up by bronze welding. Section of a bronze weld in a large iron casting.

WELFARE, SAFETY, ACCIDENTS.

Preventing and Extinguishing Magnesium Fires, by H. A. Knight. (*Metals and Alloys, May, 1943, Vol. 17, No. 5, p. 960*).

A summary of information on prevention and extinguishing equipment ; collected in U.S.A. from Government departments, fire insurance companies, magnesium producers and manufacturers of the equipment. List of " do's and dont's " are given for workers engaged in heat-treating, casting, grinding and machining Mg.

(*Communicated by the British Non-Ferrous Metals Research Association*).

WORKS AND PLANT.

Plant Layout, by A. E. Rylander. (*The Tool Engineer, U.S.A., August, 1943, Vol. 12, No. 8, p. 90, 10 figs.*).

Third instalment. Accumulation areas for parts in the event of breakdown, materials handling, and disposition of machines and their accessories.

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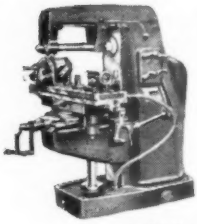

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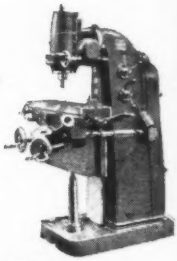

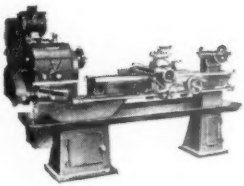

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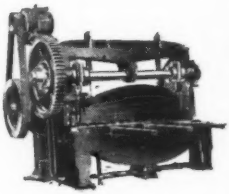

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